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PRINCIPAL INVESTIGATOR: Paul C. Mendelowitz, M.D.

CONTRACTING ORGANIZATION: Holy Name Hospital
Teaneck, NJ 07666

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6. AUTHOR(S)
Paul C. Mendelowitz, M.D.

E-Mail: mendelowitz@holyname.org

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Teaneck, NJ 07666

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14. ABSTRACT
Holy Name Hospital has undertaken a comprehensive redesign of medication management system including the introduction of pharmacy robotics; computerization of all phases of medication management including inventory, order entry with decision support, and electronic medication administration record; as well as beside bar code scanning of patient, staff and medications. The implementation of this comprehensive redesign has allowed us to conduct research to determine whether decision support will foster a reduction in adverse drug events.

We have selected 5 commonly prescribed medications that are associated with well-known adverse events that manifest as laboratory abnormalities. The use of an electronic medication administration record which incorporates bar-code scanning at the bedside allows for display of pertinent laboratory results in real time during medication administration. Review of such results provides decision support that allows for dose adjustment or discontinuation in the face of adverse laboratory trends. Our project involves studying data for 6 months of medication administration prior to the introduction of pertinent laboratory display and comparing it to 6 months of data after pertinent lab studies were available for review at the time of administration. We will examine the frequency and severity of adverse drug events in this context.

15. SUBJECT TERMS
Adverse drug reactions, medication systems, clinical pharmacy information systems, medication errors, adverse effects, drug monitoring, medical order entry systems

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Table of Contents

Introduction

The purpose of this research project is to determine if an electronic medication administration application which presents pertinent clinical laboratory parameter trends in real time during medication administration can reduce the incidence and severity of adverse medication events. Five commonly prescribed medications have been selected that are associated with adverse events reflected in laboratory abnormalities. Six months of medication administration data has been collected prior to the introduction of the real time data display. Six months of data collection is underway for medication administration with the data display is effect. We will compare the two data sets to determine the relative frequency and severity of adverse drug events for the medications under consideration. Our hypothesis is that the display of pertinent laboratory parameters that might be affected by certain medications will lead to a reduction in the frequency and severity of these adverse drug events.

Body

In November, 1999 the Institute of Medicine issued its landmark report, "To Err is Human: Building a Safer Health System" in which they reported that between 44,000 and 98,000 people die in hospitals each year as a result of preventable medical errors.[1] Adverse drug events rank as one of the most common categories of preventable medical errors. While the cost of a loss of life is inestimable, the annual total cost attributed to medical errors (including the cost of additional care necessitated by the error, lost income and productivity) is estimated to be between $17 billion and $29 billion per year.

In hospitals the complex medication administration process encompasses prescribing, dispensing, administering and monitoring. Each step in the process is prone to errors with consequent morbidity and mortality. In 2006 the Centers for Medicare and Medicaid Services sponsored a study to focus on Preventing Medication Errors.[2] The Committee that carried out and published this study estimates that "on average, a hospital patient is subject to at least one medication error per day..."[2] The Committee further finds that a large number of these errors are preventable.

In 2005 Holy Name Hospital initiated a performance improvement project to redesign the entirety of our medication management process in a comprehensive fashion with the goal of reducing medical errors, improving patient safety and improving efficiency and productivity. We began this effort with a fundamental philosophical decision that we would take a comprehensive approach to medication management. Despite the difficulty involved, we chose this approach because the number, interdependence and complexity of the various processes made piecemeal interventions unpredictable in their impact and consequences on other aspects medication administration. Only by taking a comprehensive approach could we ensure that our redesign and improvements would have their intended effects. The redesign program is described in detail in appendix A.

A major element of the medication management redesign is to employ computer technology at every step of the medication management process. It is our expectation that this will minimize human error, provide pertinent data and decision support, facilitate inventory management and monitoring. This element in our redesign process is endorsed by the Committee on Identifying and Preventing Medication Errors which strongly recommends electronic prescribing and monitoring as well as deployment of computer technology in the medication management process as essential for reducing errors.

Our Department of Defense project is based on our comprehensive medication management redesign and was constructed to test the hypothesis that introduction of computer technology at the bedside during medication administration would eliminate or mitigate adverse drug events. We have selected 5 commonly prescribed medications that are associated with well-known adverse events that manifest as laboratory abnormalities. The use of an electronic medication administration record which incorporates bar-code scanning at the bedside allows for display of pertinent laboratory results in real time during administration. Review of such results provides decision support that allows for dose adjustment or discontinuation in the face of adverse laboratory trends. Our project involves studying data for 6 months of medication administration prior to the introduction of the pertinent laboratory display and comparing it to 6 months of data after pertinent lab studies were available for review at the time of administration. We will examine the frequency and severity of adverse drug events in this context.

The comprehensive medication management redesign is described in the project document in appendix A. this section will provide a summary of the major elements of the redesign and focus on those that directly intersect with the computer technology which supports the DOD research project.

Bar Code technology: The introduction of bar code technology and commitment to bar-coded unit dose packaging of medication is a key component of the process redesign. The use of bar code technology allows for several important improvements in efficiency and opportunities for error reduction. It allows for inventory control as it allows each dose of a medication to be tracked from packaging through distribution and administration. Perhaps most importantly it allows for error reduction in that we can dispense robotically and utilize barcode scanning at the bedside of the patient, nurse and medication to have the system ensure that this is the right patient, right drug, right dose being given at the right time.

Robotics: The introduction of robotic technology into the pharmacy has been an essential element required to comprehensively redesign the medication management process. A bit more than one third of our medications arrive bar coded in unit dose fashion from the manufacturer. In order to implement an effective bedside bar code scanning solution, we needed to introduce a robotic packaging solution so that the vast

majority of our medications were bar coded. After careful consideration of several systems we selected and installed the Swisslog packaging solution (see appendix B)

The Swisslog packaging system packages unit doses of our medications and then stores them in an inventory system. The medications are them picked robotically for each individual patient. The pick is based on computerized order entry (which is currently done by the pharmacy staff from scanned hand written orders given by physicians. Physician computer order entry is currently under development and is the final piece of our comprehensive redesign to be developed.) The meds are picked in their bar coded packages and placed on a single plastic ring for delivery to the nursing unit. The robotic medication selection eliminates error in dispensing and the packaging of meds for a single patient on a single ring prevents medication errors that might occur between patients since medications for a single patient are physically isolated.

Provider order entry: Currently our physicians are handwriting their orders in the charts. The nursing staff then takes these orders and scans them into electronic format where they are transmitted to the pharmacy. The pharmacy receives the scanned orders and enters them into the system via computer order entry. They perform their verification process at this time aided by decision support technology that looks for allergies, food interactions, renal failure dose adjustment, drug interactions or duplicate therapy. The computer order now drives the robotic system for medication dispensing and it also populates the electronic medication administration record.

As the final phase of our comprehensive redesign we are developing the physician order entry module (CPOE). When this is completed and implemented we expect to have at least 75% of all of our orders (medication and otherwise) to be entered by physicians electronically. There will be substantial decision support at the point of order entry including access to knowledgebases, pertinent lab results, vital signs, etc.

The introduction of CPOE is expected to solve many problems that have plagued our system and introduced potential errors. Illegible orders will be eliminated. Use of unapproved abbreviations will be eliminated. The system will be able to offer decision support in real time to the physician concerning drug interactions, duplicate therapy, allergies, dose adjustment for various circumstances, etc.

The computerized order entry system also allows us to link all the participants, physician, pharmacist and nurse to let them know the status of medication orders to track dispensing, and administration.

Work-station on wheels: In order to effect the use of electronic MAR and bedside bar code scanning we implemented workstations on wheels (WOWs). The WOW is a rolling cart that has a wireless network computer with bar code scanner on top and storage drawers for patient medications. The WOW is a decentralized storage unit that contributes to error reduction and increases nurse efficiency in medication administration. As described earlier, most of the patient's medications for a shift are

delivered to the nursing unit on a single plastic ring. That single plastic ring is placed in the patient's medication drawer and this minimizes or eliminates any chance of mixing up a patient's meds during storage.

Electronic Medication Administration Record (eMAR): The eMAR or WebMAR as we have come to call it, is at the heart of our research project and is a critical component of our system redesign as it related to error reduction and patient safety. It is the eMAR technology that supports bar code scanning and insures the right patient, right medication, right dose and right time. If there is any discrepancy detected the system alerts the nurse and aborts the medication administration. It is through the eMAR that we are able to implement our intervention of displaying pertinent lab trends to the nurse at the time of medication administration. Screen shots of this are provided in appendix B).

The Data: The pre-intervention data set has been collected and archived. For the period January 1, 2007 through June 30, 2007 all administrations of the five selected drug categories have been queried and archived. In additional all pertinent laboratory results have been queried and archived. The development of the application to display pertinent lab trends during medication administration was completed in December, 2007. It was implemented during January, 2007 and nursing staff were in-serviced during the implementation. Therefore the data collection period for the post implementation data set was established to be February 1, 2009 though July 30. 2008. In early August the post-implementation data set will be developed and data analysis will begin on both data sets to determine the frequency and severity of adverse drug events for these medications.

Key Research Accomplishments

- Implementation of pharmacy robotics and workflow redesign
- Implementation of computer support for order entry, robotics, and most importantly bedside electronic medication administration record
- Implementation of bar code technology to support medication administration
- Implementation of the real time pertinent laboratory trend display at the time of medication administration
- Obtaining the pre-implementation data set.

Reportable Outcomes

Pending receipt of post-implementation data set and analysis.

Conclusions

Conclusions regarding our research and hypothesis are pending the receipt and analysis of the study data which is expected during August, 2008. However we have demonstrated that a comprehensive all encompassing redesign of a hospital medication

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management system to introduce computer and robotic technology is feasible and can be successful if carefully planned and executed in a comprehensive, multidisciplinary fashion.

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Appendices

Appendix A - Holy Name Hospital Plan for Medication Management Redesign

Appendix B - Photographs and Screen Shots

Appendix B-1 Medication administration screen showing pertinent lab trend data for diuretic (potassium)

Appendix B-2 Medication administration screen showing pertinent lab trend data for heparin (platelet count)

Appendix B-3 Medication administration screen showing pertinent lab trend data for statins (CPK, AST, ALT)

Appendix B-4 Explanation for pertinent clinical data display is accessed from the "what's this" link

Appendix B-5 Medication administration screen showing pertinent lab trend data for aminoglycosides (creatinine)

Appendix B-6 Medication administration screen showing pertinent lab trend data for ACE inhibitors (creatinine)

Appendix B-7 Screen during medication administration which requests bar code scanning of patient wristband.

Appendix B-8 Example of error screen if there is a mismatch between order, patient and medication

Appendix B-9 Pharmacists work stations where they receive scanned orders and perform order entry and medication verification

Appendix B-10 Pharmacist bar codes medication inventory vial to identify medication before filling the packaging container

Appendix B-11 Packaging container (with yellow tablets) is identified for the packaging system

Appendix B-12 Medications ready to be packaged

Appendix B-13 The Swisslog packaging robot picks single dose units and packages them individually in bar coded packages, then places them into inventory

Appendix B-14 The old pharmacy manual medication picking station which was replaced by the robotics

Appendix B-15 The robot medication inventory ("Drug Nest"). You see single dose bar coded packages of medication

Appendix B-16 The robot is picking medications based on the order entry for a single patient.

Appendix B-17 A single dose bar coded package of Tylenol (front)

Appendix B-18 A single dose bar coded package of Tylenol (back)

Appendix B-19 Once all medications for a single patient are picked by the robot they are placed on a plastic ring with a tag that identifies the patient and the medications on the ring

Appendix B-20 The ELO on the nursing unit where the arrival of the medication is logged in using bar code scanning

Appendix A

Holy Name Hospital

MEDICATION MANAGEMENT REDESIGN

Improving Safety and Efficiency

Holy Name Hospital

MEDICATION MANAGEMENT REDESIGN

Improving Safety and Efficiency

DRAFT

2/23/2006

Team

Rosario Lazzaro	Director of Pharmacy
Nancy Siekmann	Assistant Director of Pharmacy
Deborah Zayas	Assistant Vice President Nursing
Beverly Sanborn	Assistant Vice President Materials Management
Jon Carretta	Materials Management Manager
Mike Skvarenina	Assistant Vice President Information Tech.
Deborah Ross	Clinical Software Specialist
Kailin Tu	Director Performance Engineering

Authors

Rosario Lazzaro	Director of Pharmacy
Nancy Siekmann	Assistant Director of Pharmacy
Deborah Zayas	Assistant Vice President Nursing
Beverly Sanborn	Assistant Vice President Materials Management
Kailin Tu	Director Performance Engineering

Document History

Version	Date	Comments
draft	2/23/2006	Does not include timeline for implementation of inventory system

Table of Contents

EXECUTIVE SUMMARY

The intent of this document is to illustrate changes in our medication management process that can yield notable improvements in patient safety and efficiency. Errors can result in a significant human and financial cost and the process in place needs to be revised to reduce the risk of an error. Furthermore, the process is resource intensive and characterized by waste and rework.

This challenge to reduce medication errors is being driven by an internal commitment to patient safety and external factors. The organization is actively identifying vulnerabilities in the current medication management process. Highly publicized studies detailed in literature also continue to recognize error scenarios. These publications are spurring stakeholders such as payors, regulatory agencies, and employer coalitions to extend recommendations and/or requirements to improve patient safety.

Efficiency is a concern as the systems that support this process consume a notable amount of resources. The process is primarily manual and dependent upon proper execution of 20 or more steps. The number of steps makes the process vulnerable to errors and inefficiencies. It has become a significant challenge for all those involved as the volume of medications stored, dispensed, and administered has increased dramatically over the past 10 years.

The system itself for supporting this process has not adjusted to this increase in demand. It is clear that changes have to be made to improve the overall efficiency and effectiveness of the system. The percentage of returned medications is approximately 50%, while the number of missing medications consumes hours of additional work per day. There is a considerable opportunity to reduce waste and rework by redesigning the process.

In addition, approximately $10 million is spent on inventory each year. The inventory system in place is limited; it is a manual process and there is limited infrastructure to properly manage the inventory. A closed loop automated system needs to be implemented to facilitate procurement and control over inventory.

An interdisciplinary team is proposing a major redesign of the medication management process. The team has identified improvement opportunities and designed an effective process that takes advantage of technology to improve safety, reduce errors, and increase efficiency and productivity. The redesign reduces the risk of errors and provides a better infrastructure for tracking and managing the entire process.

The proposed process has the following goals: (1) bar code medications to reduce the risk of misidentifying a medication, (2) improve the security controls for accessing medications to reduce the chances of a medication being used inappropriately, (3) implement provider order entry to eliminating the need to keep multiple instances of an order in sync, (4) implement an order management system to assist process stakeholders in tracking the status of an order, (5) create a more efficient workflow in the central Pharmacy area, and (6) implement an information system to support the inventory management system. The following is required to realize the above goals:

- A system that assists process stakeholders verifies the identity of a medication by reading a bar code. This requires a packaging solution as approximately 35% of medications arrive from the wholesaler bar coded at the unit dose level. The Swisslog packaging solution provides a means for packaging medications on-site. Medications are packaged prior to storage locations where they are retrieved for filling patient orders. When the medication is picked for an order, the bar code is scanned to verify its identity. The bar code can also be used to track the status of an order.

- Increasing the number of routine deliveries to patient care areas can reduce the number of medications in patient care areas as orders are being filled closer to the actual administration time. This increases the workload in Pharmacy and automated dispensing technology offers the most cost effective means for increasing its capacity to fill orders in a timely manner. The Pharmacy has identified a strategy that identifies the schedule and resources required to dispense medications using automation. The Swisslog DrugNest is an automated dispensing unit that incorporates robotic technology to dispense unit doses for the majority of orders. It has a number of attractive features not offered by other vendors. First, it can house two robotic arms and each arm can store or retrieve a medication. The robot is also physically interfaced with the packaging and medications can be stored immediately after they are packaged. The unit can also place the medications for a patient on a ring with a ticket that lists the medications stored on the ring. Each package has a unique identifier providing the means to track whether the medication that was dispensed for a patient was actually used for a particular order. There are items that cannot be stored in the DrugNest due to certain constraints such as capacity limitations of the robot or size of the medication packaging. These items are stored in the McKesson MedCarousel that houses a series of

rolling shelves in a vertical housing. It reveals relevant shelf where the item is stored as it receives an electronic request. Medication orders are sent to the Swisslog DrugNest and any items not in the DrugNest are sent to the carousel. The advantages of this technology are: (1) can cut down on the search time of certain items, (2) uses the bar coding technology to verify the identity of the item picked, (3) reduces the space need to store the medications.

- Bar coded medications stored in patient care areas are more secure in an automatic dispensing machine (ADM). The current scheme for securing floor stock medications relies on the care providers to The ADM requires the care provider to identify his/herself. An interface requires the care provider to select an order specific to a medication stored in the ADM or, in emergent situations, to select a patient and medication. The appropriate medication is offered to the care provider. This technology provides an effective scheme for managing access to floor stock medications. It can also save time as the nurse does not have to spend time searching for keys to access the narcotics.

- The order management system tracks the status of each order as it is processed. Currently, the HIS can indicate when an order is scanned and profiled. The system should also capture the time (1) when it is picked, (2) when it is verified by the Pharmacist, (3) when it sent through the pneumatic tube, (4) when it is received in the patient care area, (5) if it is delivered by a pharmacy tech, the time the item arrives on the nursing unit.

- Electronic order entry creates a single copy of the medication order and eliminates the need to sync copies of the order that are created in the current system. This electronic order is reflected on the electronic medication administration record (WebMAR). The nurse accesses the record at the bedside using a Artromick Initi Mobile Computing Workstation. The WebMAR guides the nurse through the verification process (the 5 R's) using a scanner to scan the medication's bar code and the bar code on the patient's bracelet.

- The medications are delivered to a central medication room where the medications are stored in bins according to room number. The nurse takes the medications from the bins and stores the medications in a patient specific drawer in the computer workstation. This is a safer and more efficient scheme than the one currently in place. It reduces the time the nurse handles the medication prior to administration and reduces the chances of the nurse making an error. Also, the nurse no longer needs to walk back and forth between a central point where the medication is stored and the patient's room. The nurse spends less time administering medications.

- An application is required to provide accurate and timely inventory information. The system should communicate with the automated dispensing units (i.e. robot, carousel, and ADM). It can provide a recommended order in electronic format that can be read by the wholesaler system. The counts reflect items located in the central pharmacy and patient care areas.

CURRENT PROCESS AND SYSTEM

Ordering, Dispensing, Administration

The overall process begins with the physician obtaining information regarding the patient's condition and prescribing a medication for therapeutic purposes. The handwritten order is sent via a document scanning program to the pharmacist. The pharmacist transcribes the order and evaluates the order using the RXO application. (The Pharmacy processes approximately 1,200 orders per day.) If any discrepancies arise during the evaluation, the Pharmacist confers with the ordering physician.

A hard copy of the pick notification is sent to a pharmacy technician who retrieves the medication from storage. A Pharmacist must check each order prior to delivery. Orders for administration times after 2:30PM are sent via a cart exchange, where the pharmacy technician removes a cartridge of patient specific drawers and replaces it with a cartridge containing medications for the next 24 hours. Deliveries involve the following patient care areas: LN, 1NO, 2M, 3M, LDRP, 4M, 5M, 6M, Pediatrics, HNP, ICU. Currently, this takes approximately 10 staff hours to pick the meds and 5 staff hours to check the meds. With 2 technicians and 1 pharmacist working simultaneously, the entire process is typically completed in 5 hours.

If a new order has a stat priority, it is sent via pneumatic tube or messenger. The messenger delivers the medication, if the patient care area is not connected to the pneumatic tube network. Stat orders should be administered within 40 minutes from the time the order is written. Missing med requests and first dose orders not covered by the 24 hour exchange also are sent through pneumatic tube or messenger. First dose orders are to be administered within 120 minutes after the order is written. These orders (STAT, Missing, First doses) also require a Pharmacist to check the order prior to delivery. The messenger places medications in a defined bin in the medication room. Doses sent via the pneumatic tube are handled by nursing upon arrival.

Floor stock medications reside in patient care areas for emergent situations. These are kept in boxes or cabinets in a locked medication room. Nurses should access these medications after an order is written. This order is eventually sent to the Pharmacy who profiles the order. These boxes are exchanged and refilled everyday. The cabinet stock is requested by a Floor Stock Order Form which is filled as needed by a Pharmacy Tech. The following areas have floor stock: LN, 1NO, 2M, 3M, LDRP, 4M, 5M, 6M, Pediatrics, HNP, ICU, PACU, OR, SDS, ER, Cardiac Cath, Cancer Center, Hemodialysis, and Radiology/MRI.

Area	Services
LN 1E 2M 3M LDRP 4M 5M 6M Pediatrics HNP ICU PACU	• Daily delivery of routine doses that are stored in carts between 2PM and 3PM • Daily delivery of IV solutions that are stored in medication room • Delivery of stat and first dose medications 24 hours per day, 7 days per week • Refresh floor stock • Refresh narcotics
OR SDS	• Trays for anesthesiologist, OR cart filled and exchanged 3x weekly • Refresh floor stock, Daily delivery of patient specific orders for the following day
ER Cardiac Cath Cancer Center Hemodialysis Radiology	• Refresh floor stock, Routine/Stat orders for non-floor stock items, 24/7

After an order is written on the nursing unit, the nurse validates the order. If they identify a problem with the order, they contact the ordering physician. Once the order is validated, the order is written on the Medication Administration Record (MAR). The MAR is used to track the administration of a medication. A second nurse checks this transcribed entry prior to administering the medication the first time.

The nurse retrieves the medication from its storage location in a 2 hour window around the standard administration time. They can administer the drug as early as an hour before and an hour after the administration time. The following steps involve verifying the drug's identity, dose, route, frequency and the patient's identity. This is commonly referred to as the "5 Rights."

In order for these medications to be available, the Pharmacy takes steps to manually track its inventory. The medications stored in the central Pharmacy area are reviewed 5 (on Sundays the staff calls the supervisor to order any pressing items from home) days a week to identify items that need to be reordered. The order is reviewed and price comparisons for certain items are sought. McKesson provides an application to submit the order electronically. Orders are delivered 6 days per week, Mon-Sat.

Systems That Support the Process

The three systems that support the medication management process are as follows: order management, inventory management, and materials management. Order management regards tracking an order from the time it is entered through its completion. Inventory management involves all the processes for identifying inventory status, inventory targets, and replenishment. Materials management consists of the tasks that involve the handling of medications including ordering, receiving, re-packaging (when necessary), delivering and storing.

Each of these systems interacts with each other. The order management system must be aware of inventory data. The use or non-use of an item is reflected by the order and this information should be fed back to inventory. As an order is being processed the tasks associated with materials management provide feedback to the order management system so it can provide a status on the order. All of this is necessary to close the loop.

IMPROVEMENT OPPORTUNITIES

Patient Safety

As a reference point, the team has drawn upon internal analyses of the process and external literature detailing studies to identify improvement opportunities and illustrate the impact of these errors from a human and financial standpoint. Since the process has many steps and requires many roles, one can identify more than 70 error scenarios. For each of these errors, the causes and frequency of the errors varies.

The team is focusing upon a few critical patient safety issues. Addressing these critical points is expected to reduce the risk of an error:

- Identification of an error at administration
- Misidentifying a medication during dispensing
- Refocusing pharmacist role from dispensing to clinical (therefore cost saving) efforts

Efficiency

The demands on the process have increased considerably in recent time due to an increase in the number of medications available. The process itself has not been amended to meet these demands. Below are key issues:

- Waste and rework

  The Pharmacy receives a large number of returned doses. A recent sample of doses due between 2:30pm on 9/26/2005 and 2:30pm 9/27/2005 indicated that 54.1% of the doses were returned. The total number of doses dispensed for this time period is 2,958. A dose is returned when the physician discontinues an order. Doses for routine orders are sent every 24 hours and many doses are sent far in advance of the administration time. This results in a high number of returns as the physician can submit an order at any point during a 24 hour period.

  Through September 2005, the total number of missing medication requests was 34,991. The percentage of administration events that result in a missing medication was 2%. This was an average of 130 requests per day. If the average time spent on each request is 5 minutes, the total time spent on missing medications was 650 minutes per day.

- Turnaround Time for Stats and Routine Doses

  A small sample of 27 stat orders taken in mid 2004 indicates that only 19% of stat orders arrived at the patient care area within 40 minutes after the order was received by Pharmacy. For other routine orders, during that same time period, an analysis of 72 orders indicated that 81% arrived within 2 hours.

  A second time study conducted later that year looked at 78 deliveries sent by messenger and 25 sent by pneumatic tube. This effort focused upon the time it took from profiling to when delivery was initiated. For orders sent by messenger, the average turnaround time was 29 minutes with a standard deviation of 14 minutes. The tube orders took less time and averaged 12 minutes with a standard deviation of 6 minutes. The performance discrepancy is due to the constant availability of the tube.

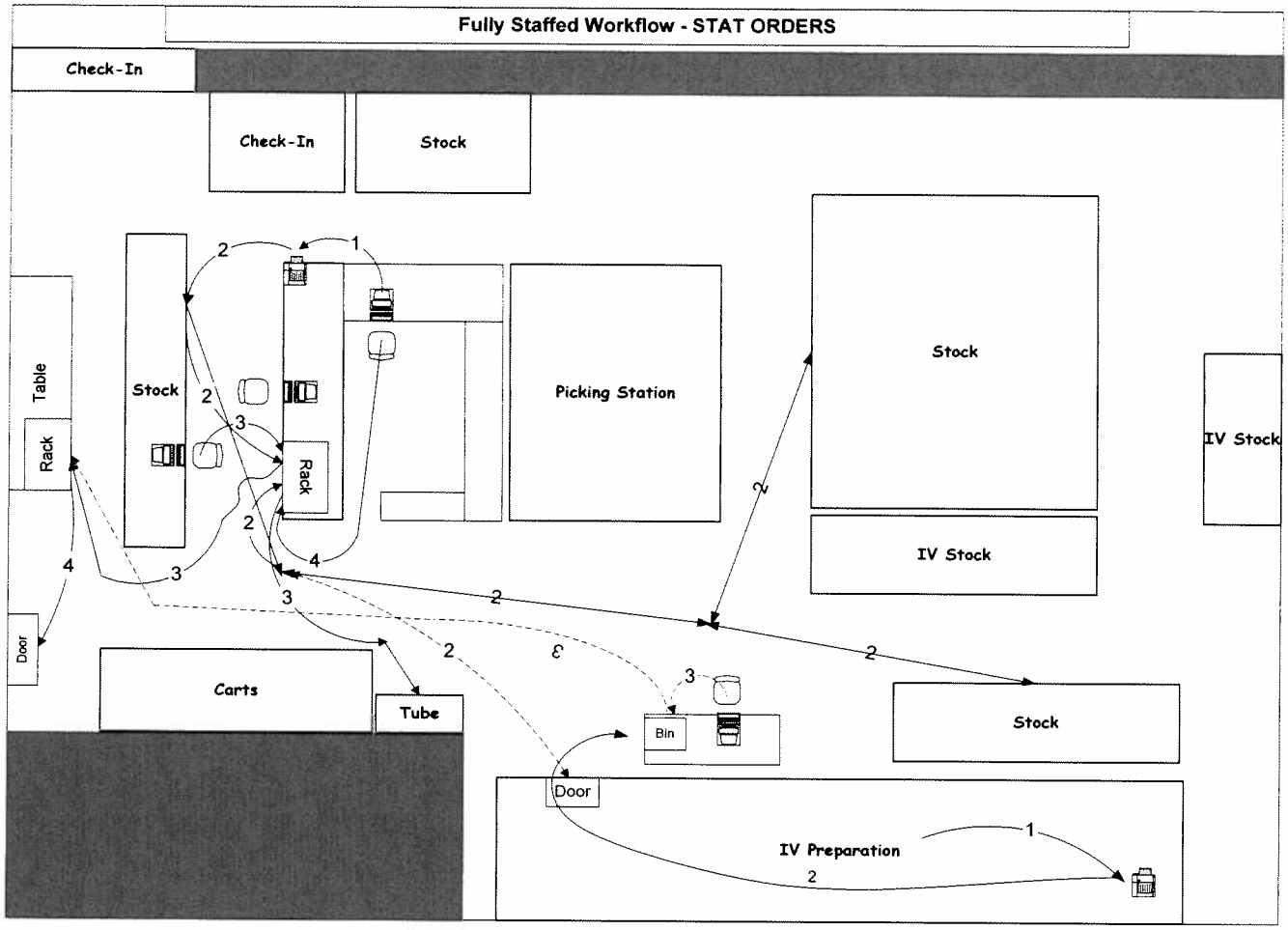
  The installation of the pneumatic tubes in more nursing units is going to improve turnaround time. However, the variation for the tube deliveries is high and indicates the process is unstable as the standard deviation is large with respect to the average. There is room for improvement in the steps from profiling the order to the point prior to delivery.

- Inadequate Central Pharmacy Area and Layout

  The overall square footage and layout of the central pharmacy is inadequate. Rolling shelves are used to store medications and these shelves are inappropriate for work that requires medications to be frequently accessed by Pharmacy personnel. The limitation in space also forces Pharmacy to store medications in several areas. The

narrow aisles and lack of work area affects turnaround time and the ability to organize and implement an adequate workflow.

The following diagram illustrates the workflow for filling stat medication orders.



Description of Facility Workflow Diagram – STAT ORDERS

(Note: The dimensions the facility layout is not to scale)

- **Activity 1** – The pharmacist selects a scanned written order, reviews, and processes the order. A label indicating the required medication is produced by a printer.
- **Activity 2** – The pharmacy tech picks the labels randomly (either STAT or ROUTINE) from the printers. The medications are retrieved from a variety of locations. The bagged medications are then kept in a bin pending the pharmacist's verification.
- **Activity 3** –
    - **Oral Orders** - Any of the three pharmacists then verifies the medications. The medications then are either kept in the exit rack for the messenger to pick up for delivery or sent through the pneumatic tube (5 Marian and sometimes 6 Marian, 1 North).
    - **IV and Others:** The specialized pharmacist verifies the medications. It is then kept in the exit rack for the messenger to deliver or sent through the pneumatic tubes (5 Marian, Infusion Center and sometimes 6 Marian, 1 North, Hemodialysis).
- **Activity 4 –** The medications in the exit rack are then sorted by the messenger and delivered to unit after certain time intervals.

- Limited Infrastructure to Control Inventory

  The cost of medication inventory is significant and this impacts cash flow and other costs associated with carrying inventory. The total dollar figure for medications purchased by Pharmacy in 2004 is $9,831,354. The annualized figure for 2005 is projected to be $12,448,966. The year-to-date figure for turns for 2005 is 17.3. The value of the floor stock from a recent review is $51,131.

  Currently, the Pharmacy does not have an automated system in place to assist them in effectively managing and controlling the inventory. While there are processes in place to meet demand, they lack the resources that would collect and provide the information to effectively manage the inventory.

- Improve Controls for Accessing Medications

  In the current system, medications stored in patient areas either reside in carts or in the medication rooms. The carts in use have exceeded their life expectancy and frequently break down. Carts must be locked and the locking mechanism is unreliable. The vendor does not have spare parts to support the carts. This is an inadequate scheme for storing patient specific medications.

  Non-controlled floor stock is kept in secured containers that resemble fishing tackle boxes or in cabinets (ICU, 1 North, PACU, etc). When the nurse accesses the box, the nurse must document the medication retrieved in a written log. This setup provides little control over accessing medications as the nurse has access to all medications in a box once it is opened.

  There is also an opportunity to reduce the amount of time the nurse spends handling medications. The chances of an error increase in proportion to the time the nurse handles a medication. Carts are stored in a central location on the unit. It is safer for the nurse to access the medications for a patient as close to the bedside as possible.

REDESIGNED WORKFLOW OVERVIEW

Goals

The following are key objectives of the redesigned process:

- Bar code medications to enable verification of all medications from receiving to administration

  The identity of each medication is verified when it is picked and just prior to administration. Each medication has a bar code that uniquely identifies that medication's dose and form.

- Improve controls governing the access to medications

  Reducing the number of medications on the floor can be achieved by replacing the 24-hour exchange with multiple exchanges, with medications dispensed as close as possible to the administration time. Risky behavior such as borrowing, hording, and stealing medications for another patient or use, is less likely to occur and it is easier to monitor location, usage, administration, returns or waste at any time through the institution.

- Provider order entry

  A physician entering in an electronic order eliminates the need for Pharmacy and Nursing to transcribe an order and keep each instance of the order in sync. Expert system technology that issues warnings such as allergy checks and drug interactions provides a more immediate means of resolving a problem with an order.

- Create an order management system

  The order management system enables all stakeholders to track the status of an order as it is processed. This includes identifying when it has been ordered, transmitted to Pharmacy, profiled, picked, verified, delivered, administered, returned and/or wasted. Capturing this information allows stakeholders to review process performance and improve accordingly.

- Implement New workflow in the central Pharmacy area

  This includes the implementation of automation and a new layout in the central Pharmacy to reduce turnaround time for filling orders, control inventory, and increase turnover.

- Implement a software solution to support the inventory management system

  The inventory management system should optimize inventory levels, identify status, and reduce and/or prevent stock-outs.

- Reassigning roles in Pharmacy

  Reassigning staff roles within the Pharmacy can support processes focusing on clinical and purchasing interventions that can improve safety and save money.

New Workflow

Orders are reviewed by the pharmacist and electronically sent to either the robot or carousel. The robot dispenses any items located in its storage. Any other items not picked are sent in an electronic request to a carousel. The tech gathers items from the robot and carousel and scans a bar code to verify the order has been picked. A Pharmacist checks any manually picked items and scans the bar code once this is complete. The meds are sent either by tube or the exchange. If the meds are sent by tube, the unit secretary or other designated nursing personnel retrieves the item from the tube and scans the item. This med is then stored in the central med room. Meds delivered during an exchange are also left in the med room.

In the redesigned process, the care provider uses an electronic interface that captures the order. The order entry application has the ability to check the order and relate a warning if it identifies an allergy, an interaction with another

drug, or a necessary dosage adjustment. Orders entered directly into the system by the provider eliminate the need to sync multiple copies of the order created by our current system.

Bar coding medications is another opportunity to reduce the risk of an error. The bar code is a means for verifying the identity of a medication when during the dispensing and administration phases. Since only 35% of medications arrive from the wholesaler with a bar code associated at the unit dose level, the Pharmacy needs a strategy to apply a bar code to each dose.

Bar coding also plays a key role in the ability to distribute medications in a multiple exchange system. Limiting the amount of medications in patient care areas reduces the chance of a medication being used inappropriately. Care providers do borrow and stash medications. Increasing the number of exchanges to three should reduce the risk of those errors and also reduce the number of unnecessary picks by the pharmacy techs. A multiple exchange system increases the workload of the tech as they have to pick more frequently.

Automation plays a key role in dispensing medications accurately and efficiently. Robotic technology in the central Pharmacy that automates the picking offers the Pharmacy a few advantages. First, it picks more accurately as all robotic solutions use bar codes to identify a medication. It also reduces the number of techs required to manually pick for three exchanges a day. A robot can accept the electronic order, pick the order, and bundle orders by patient.

The current plan involves three exchanges for routine medication orders. After reviewing data on high volume administration times (10AM, 6PM, and 10PM) and staffing scenarios, the plan is for the exchanges to occur at 8:00 AM, 4:00 PM, and 11:00 PM.

Average Number of Picks by Administration Time (Excludes PRNs, LV, PBs)

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0	99	104	104	108	108	98	98
1	1	1	1	1	1	1	1
2	97	99	102	105	105	98	99
3	1	1	1	1	1	1	1
4	1	2	2	2	1	1	1
5	0	0	1	0	0	0	0
6	215	223	225	232	232	216	216
7	13	18	18	15	16	12	14
8	36	39	39	55	49	26	28
9	34	35	32	44	35	22	24
10	1110	1147	1157	1157	1140	1044	1048
11	35	37	42	44	39	31	29
12	118	122	129	132	131	110	111
13	21	23	23	26	22	19	16
14	218	226	240	232	223	202	201
15	17	16	21	18	14	13	11
16	21	19	24	22	19	18	17
17	15	15	15	14	12	11	11
18	634	653	663	653	657	604	599
19	14	14	13	13	13	9	8
20	19	18	16	21	19	13	13
21	14	12	12	15	12	8	8
22	430	443	445	426	432	390	387
23	8	10	8	10	8	4	4
Total Picks	3173	3277	3330	3346	3289	2953	2946

Another automation technology that can be used in central Pharmacy is the carousel. The carousel is a unit that has rolling shelves. It can be used along with the robot as the robot does not have the capacity to store all items. The software driving the carousel can accept an electronic order and automatically present the shelf where the medication is located. It even has lights located near the item to help guide the tech in picking the item. This assists the tech in picking the correct item and reduces the amount of time to locate an item. These same features also provide assistance when stocking items.

For medications dispensed outside of the central Pharmacy area, the automated dispensing machine (ADM) can assist in controlling access to medications and assist in managing inventory. The ADM has a series of drawers each of which is dedicated to a single medication. Medications are stored in patient care areas include those that are needed immediately or those that are used if needed. These include controlled substances, other medications required for emergent situations, and PRNs (medications only used as needed). The nurse must use the electronic interface on the ADM to access the medication. It has the facility to dispense medication only after the Pharmacist has reviewed the order or provide immediate access to a medication for an emergent situation.

Medications are delivered as follows. Stat and first doses are delivered via the pneumatic tube. Pharmacy techs deliver other orders the patient care areas multiple times per day. With regards to automated dispensing cabinets, the pharmacy techs stock them on a routine basis.

The nurse takes the medications along with a workstation cart that houses a computing device to the patient's bedside. There the nurse accesses the electronic Medication Administration Record (WebMAR) by identifying themselves using a proximity reader. The WebMAR also guides the nurse through the process of verifying the 5 R's (right patient, right medication, right dose, right time, and right route). The scanner on the cart is used by the nurse to scan (1) the patient's ID band to verify the patient's identity and (2) the bar code associated with the medication.

SYSTEMS TO SUPPORT REDESIGNED WORKFLOW

Order Management

The volume of orders requires a system that can assist all process stakeholders in identifying the status of an order. An order management system would relate the following states and the time of the last action: order entered, order scanned (for those orders still written on paper), order reviewed by the Pharmacist, picking complete, Pharmacist check, placed in pneumatic tube, received from pneumatic tube, and time of administration. Tracking orders also provides data for quality purposes.

The first version of the WebMAR is currently being tested. The rollout is dependent upon identifying a long-term bedside computing device and packaging all dispensed medications. Initial development on CPOE has occurred internally.

The order tracking system provides the ability to track an order from beginning to end. It can provide a status of each order to the stakeholders in the process. The current system has the ability to describe when the order was scanned, profiled, and administered. Additional information that need to be captured includes when it was picked, verified by the Pharmacist, loaded and sent by pneumatic tube, retrieved from the pneumatic tube, and delivered to the cart.

Inventory Management

The goal is a perpetual inventory management system. This requires a software application to capture inventory data and present a real-time update of the inventory status. The system must be able to capture real-time inventory data from the automated components such as the robot, carousel, ADM's and narcotic system. The application should also facilitate the ordering process by identifying a recommended order based upon the existing quantity.

The computer information systems that support the inventory management system and other technology such as the robots, ADM's, and carousel are all critical components of the solution. There needs to be personnel within the Pharmacy to support the maintenance and troubleshooting activities.

Another information system solution is the inventory management system. This system could relate the quantity of each item in inventory by location. It can generate an electronic order suggesting items and quantities for reordering purposes.

Items received from the wholesaler are verified against an invoice. Items to be picked from the robot are first stored in the robot. Those that are picked from the carousel are packaged and then stored in the carousel. The inventory levels in both the carousel and robot are filled at least once per day. Narcotics are also bar coded and stored in a separate secure area. ADM's can electronically pass along a refill request.

Materials Management

Packaging

In order to realize bedside scanning of medication bar codes for verification at administration, all medications need to be associated with a bar code. Less than 35% of medications arrive from the wholesaler with a bar code that can

be used at administration. Packaging can occur on-site or off-site through a third party. On-site packaging requires space, staff, equipment, and supplies. Note that certain items such as liquids need to be done off-site.

Storage/Picking

Each dose that is packaged is stored in either an automated dispensing unit or other location. The automated dispensing units include a robot and carousel located in the central pharmacy. Other items are going to be located on shelves, in refrigerators, etc. All storage areas in the Pharmacy are positioned with respect to the workflow. In patient care areas, floor stock medications reside in an automated cabinet (ADM) or a workstation cart. IV's are stored in the medication room.

Robotic Dispensing Unit

The robotic dispensing unit is necessary to be able to make multiple deliveries per day. Currently, it takes approximately 4 hours for 2 techs to fill orders spanning a 24 hour timeframe. The estimated pick rate per tech is 135 items per hour. The robot can pick around 600 items per hour. Replacing the 24 hour exchange with 3 exchanges doubles the amount of picks. If a robot is not used, the number of additional FTE for 3 exchanges per day is approximately 8 FTE.

In addition to the high pick rate, the robot picks accurately. By reading bar codes on the packaging, it is supposed to be close to 100% accurate. Manual picking is not as accurate as a Pharmacy Tech can make mistakes for various reasons: (1) Sound-Alike-Look-Alike-Drugs (SALAD), (2) confusing medications with similar packaging, and (3) taking the wrong quantity. Also, the robot also eliminates other manual work by alerting the Pharmacy Techician when the quantity is running low for an item.

The robot accepts electronic orders directly from a pharmacy information system. The order triggers the system to pick the item from storage. Each robot presents the picked item differently. Some can dispense the items directly into a drawer. Others can group the items such as by patient and place them into a container or place them on a ring in chronological order.

It should be also noted that there are limitations in what can be stored in the robot. Each robot does not offer enough storage to house all items stored in the central pharmacy. It also requires the packaged medication to meet size and/or packaging requirements. There are also stability and storage requirements (refrigeration).

Carousel

The advantages of a carousel are as follows: (1) improves picking accuracy, (2) saves space, (3) improves inventory control, and (4) simplifies the need to manage the physical storage space. The carousel is a tall, rectangular unit with rotating shelves that can automatically move the location of the item to the user. This reduces the amount of physical space normally taken up by shelves and aisles.

The location of each item is managed by the carousel software. The central pharmacy area does not have much floor space and it is a challenge storing 2,500 line items in an accessible location with respect to the workflow. Currently, a pharmacy tech has to manage the space by moving items as new ones are added and others are removed.

CDS's are handled separately from other inventory. There are regulations regarding the storage, tracking, and distribution. Compliance requires resources to meet these regulations. The current process is manual and there are solutions available that would reduce the manpower required and free personnel to perform other activities.

ADM

ADM's allow the hospital the ability to improve in two areas: access control and dispensing. These units can limit access to medications by only offering the medication that is requested. Also, these units provide the ability to profile dispense where a medication is only released if there is an accompanying order. This improves the security of the medications and it improves safety associated with floor stock medication dispensing practice. It discourages diversion and theft. This is also a paperless system and reduces the amount of administrative work (e.g. narcotic worksheet requires 3 counts per day) needed to track usage. Another effect on time is the need to look for keys to access the narcotics. Certain nurses have the keys and nurses can spend time locating these individuals.

This is also a JCAHO requirement.

The workstation cart is a computer on wheels that features drawers for storing medications. The cart is a decentralized storage scheme that reduces the risk of an error and minimizes the work performed by the nurse during administration. The chance of a medication error increases the longer the nurse handles a medication. If the medications are stored in a central area, the nurse has to walk back and forth from that central location. It is at this point that the nurse can become distracted and lose track of the medications they are handling.

There will also be a tendency for nurses to take meds for more than one patient during medication administration also increasing the risk of error by leaving the medication for another patient in the wrong patient room. They would still need to go back to a central area to retrieve other supplies for medication distribution (e.g. tubing, alcohol, etc.). This would further decrease efficiency and lead to supplies being left in the patient to have the necessary supplies at the point of service.

Implementing mobile workstations provides a more efficient scheme from a workflow perspective. The Pharmacy Tech would leave the meds in the appropriate patient specific bin and the nurse would load their cart with the medications. After gathering additional items in a central medication room the nurse can then proceed to each patient room in succession. Any medications to be returned are placed in a *return* bin by the nurse.

RESOURCE SUMMARY

Implementation

Order Management

DEVELOPMENT & IMPLEMENTATION
2 FTE developers
Scanning equipment
15 PC's*
.1 FTE Training Time

* NOTE: equipment for tracking system only

Inventory Management

DEVELOPMENT & IMPLEMENTATION
.25 FTE developers

Materials Management

DEVELOPMENT & IMPLEMENTATION
1 Oral Solid Packager
1 Over-wrapper
1 Barcode labeling unit
Space to setup packaging environment

Operations

Pharmacy

OPERATIONS
1 Automated dispensing unit for central pharmacy (Robot)
1 Carousel
27 ADMs
60 Workstation carts
Area to park carts in patient care area
Area to place ADM's in patient care area
6.5 FTE Pharmacy Techs for filling orders (Note: No additional FTE's are required)
1.0 FTE Pharmacy Techs for maintaining and filling ADM's (Note: No additional FTE's are required)
1 FTE Inventory Tech (Note: No additional FTE's are required)
0.75 FTE Pharmacy Tech for packaging (Note: No additional FTE's are required)

	Night	RP-Central RP	1st Floor RP	2nd Floor RP	3/4 Floor RP	5/6 floor RP	IV Room RP	Charge RP	Evening RP	Evening RP	ROBOT
7:00	Manual cart pick checks	Manual cart pick checks	Covers orders for all floors		Covers orders for all floors			Manual cart picks and order coverage as needed			Returns, 1st doses
7:30											
8:00		Central Pharmacy orders (LNo), phone calls, check ROBOT refills	Goes to 1 North Covers orders for 1 North, 1 East, ED	Goes to ICU Covers orders for ICU, 2 MR, Endo, PMU, SDS	Goes to ?? And covers 3 MR, LDRP, 4 MR, HNP	Goes to 5 MR and covers 5MR, 6MR, Pedi	IV Room	Float, scheduling, training, oversee operations, handle problems, outpt RXs, etc. Take lunch when appropriate. Also can cover for sick calls,			
8:30											
9:00											Refill Robot
9:30											
10:00											
10:30											
11:00											
11:30											
12:00		Lunch	Lunch	Cover 1st Lunch	Cover 1st Lunch	Lunch					Fills Meds due 1800-0200
12:30											
13:00		Manual cart pick checks	Covers 3/4 floor/ orders for 1 North, 1 East, ED	Lunch	Lunch	Covers 2nd floor/ 5MR, 6MR, Pedi	Lunch	Lunch			Returns, 1st doses
13:30											
14:00				Goes to ICU Covers orders for ICU, 2 MR, Endo, PMU	3MR/LDRP/ 4MR/HNP		IV Room	Package narcotics			
14:30											
15:00									TPN if needed/start orders	Start orders all floors	
15:30											
16:00						Cover breaks			Break		
16:30									Orders - 1st, 2nd floors	Break	
17:00											
17:30										Orders, Lobby, 3/4/5/6	
18:00											Fills Meds due 0201-0959
18:30											
19:00											Returns, 1st doses
19:30											
20:00											
20:30	On 3 day weeks do manual pick checks								Cover all orders	Manual pick checks/cont orders	
21:00											
21:30	Manual checks if needed, SDS orders, SIP review, Vancoymcin review								1st, 2nd floors	Lobby/3/4/5/ 6	
22:00											
22:30											
23:00	Order entry, prep, manual checks as possible, etc.										
23:30											
0:00											
0:30											
1:00											
1:30											
2:00											Fills Meds due 1000-1759
2:30											
3:00											
3:30											
4:00											Returns, 1st doses
4:30											
5:00											
5:30											
6:00											
6:30											

Staffing Assumptions:

Robot Load Rate: 600/hr.
Robot Dispensing Rate: 1,000/hr.

Average Number of Picks by Administration Time (Excludes PRNs, LV, PBs)

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0	99	104	104	108	108	98	98
1	1	1	1	1	1	1	1
2	97	99	102	105	105	98	99
3	1	1	1	1	1	1	1
4	1	2	2	2	1	1	1
5	0	0	1	0	0	0	0
6	215	223	225	232	232	216	216
7	13	18	18	15	16	12	14
8	36	39	39	55	49	26	28
9	34	35	32	44	35	22	24
10	1110	1147	1157	1157	1140	1044	1048
11	35	37	42	44	39	31	29
12	118	122	129	132	131	110	111
13	21	23	23	26	22	19	16
14	218	226	240	232	223	202	201
15	17	16	21	18	14	13	11
16	21	19	24	22	19	18	17
17	15	15	15	14	12	11	11
18	634	653	663	653	657	604	599
19	14	14	13	13	13	9	8
20	19	18	16	21	19	13	13
21	14	12	12	15	12	8	8
22	430	443	445	426	432	390	387
23	8	10	8	10	8	4	4
Total Picks	3173	3277	3330	3346	3289	2953	2946

NOTE: Current Average # of Picks for 24 Hr. Exchange (Oct 26 - Nov 9): 1221

Pick Hours Estimation

Assumptions:
80% of picks are from robot
Robot Pick Rate (per hour): 600
Manual Pick Rate (per hour): 100

3 EXCHANGE SCENARIO: 9AM, 5PM, 11PM

Based upon Wednesday

10am-5pm			2 TECHS		1TECH		3TECHS	
Picks 80%	20%	Robot Hours	Techs Hours		Techs Hours		Techs Hours	
1320	330	2.2	1.7		3.3		1.1	

6pm-1am			2 TECHS		1TECH		3TECHS	
Picks 80%	20%	Robot Hours	Techs Hours		Techs Hours		Techs Hours	
1013	253	1.7	0.9		2.5		0.6	

2am-9am			2 TECHS		1TECH		3TECHS	
Picks 80%	20%	Robot Hours	Techs Hours		Techs Hours		Techs Hours	
363	91	0.6	0.3		0.9		0.2	

2 EXCHANGE SCENARIO: 9AM, 5PM

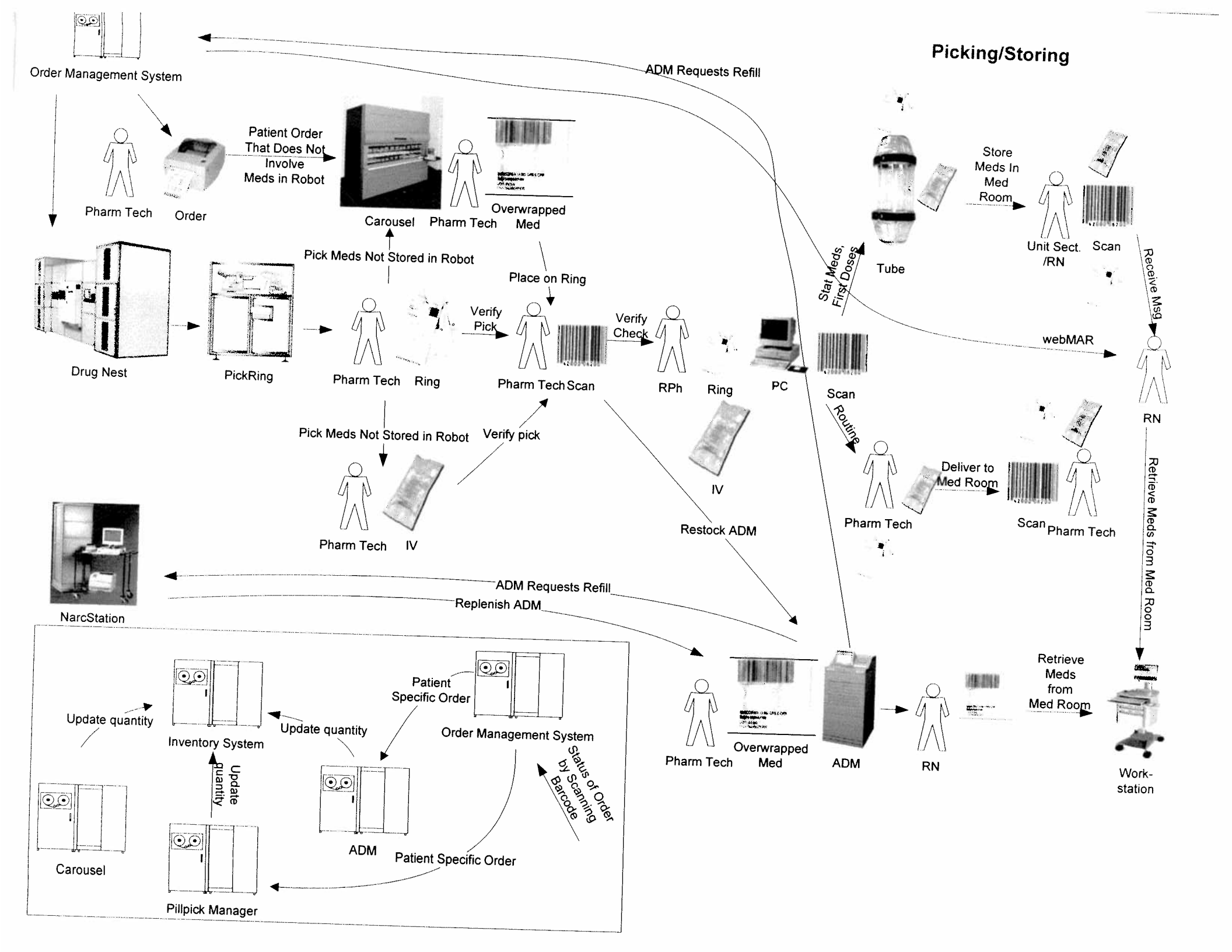
Based upon Wednesday

10am-5pm			2 TECHS		1TECH		3TECHS	
Picks 80%	20%	Robot Hours	Techs Hours		Techs Hours		Techs Hours	
1320	330	2.2	1.7		3.3		1.1	

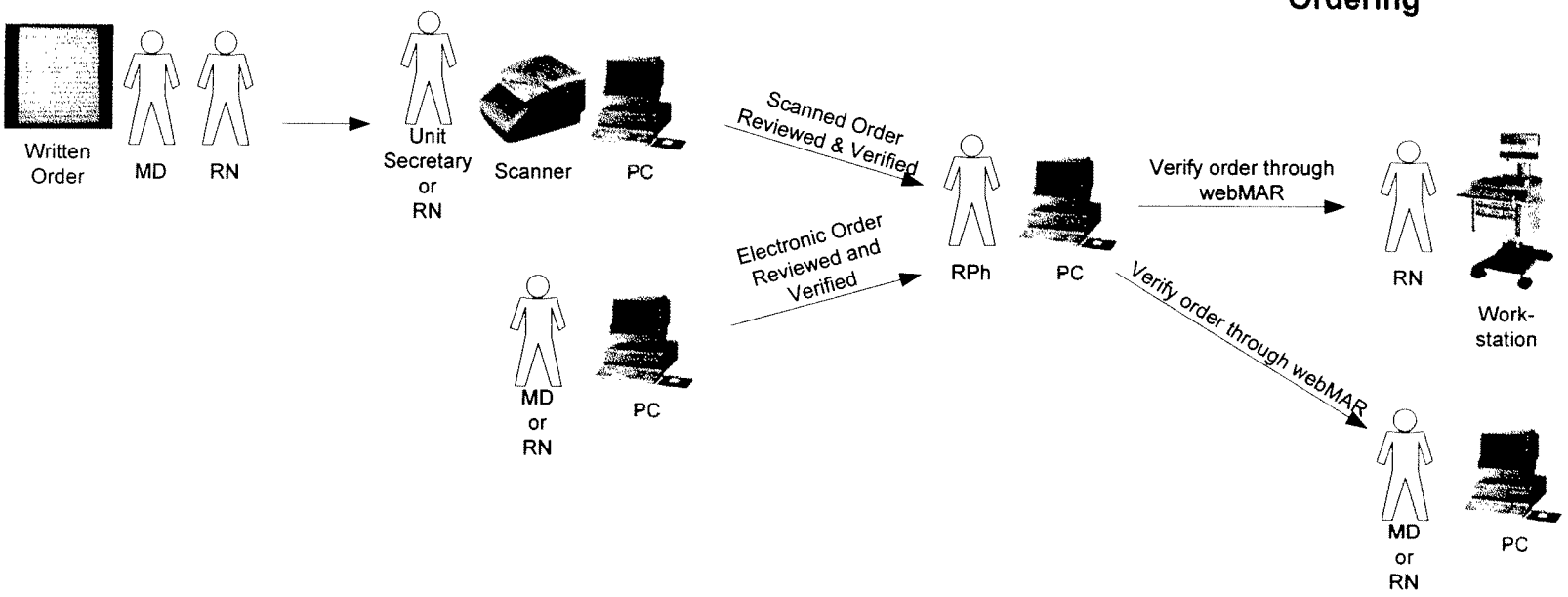
6pm-9am			2 TECHS		1TECH		3TECHS	
Picks 80%	20%	Robot Hours	Techs Hours		Techs Hours		Techs Hours	
1376	344	2.3	1.3		3.4		0.8	

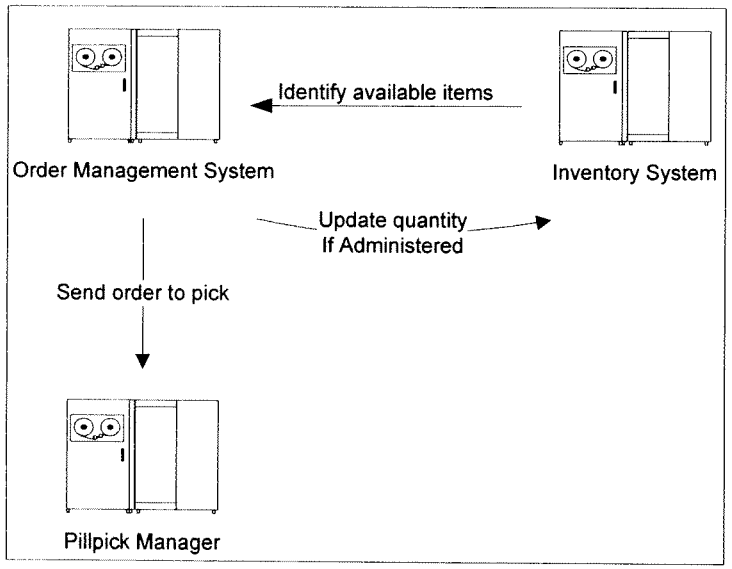
WORKFLOW DIAGRAMS

The following diagrams illustrate the proposed workflow.

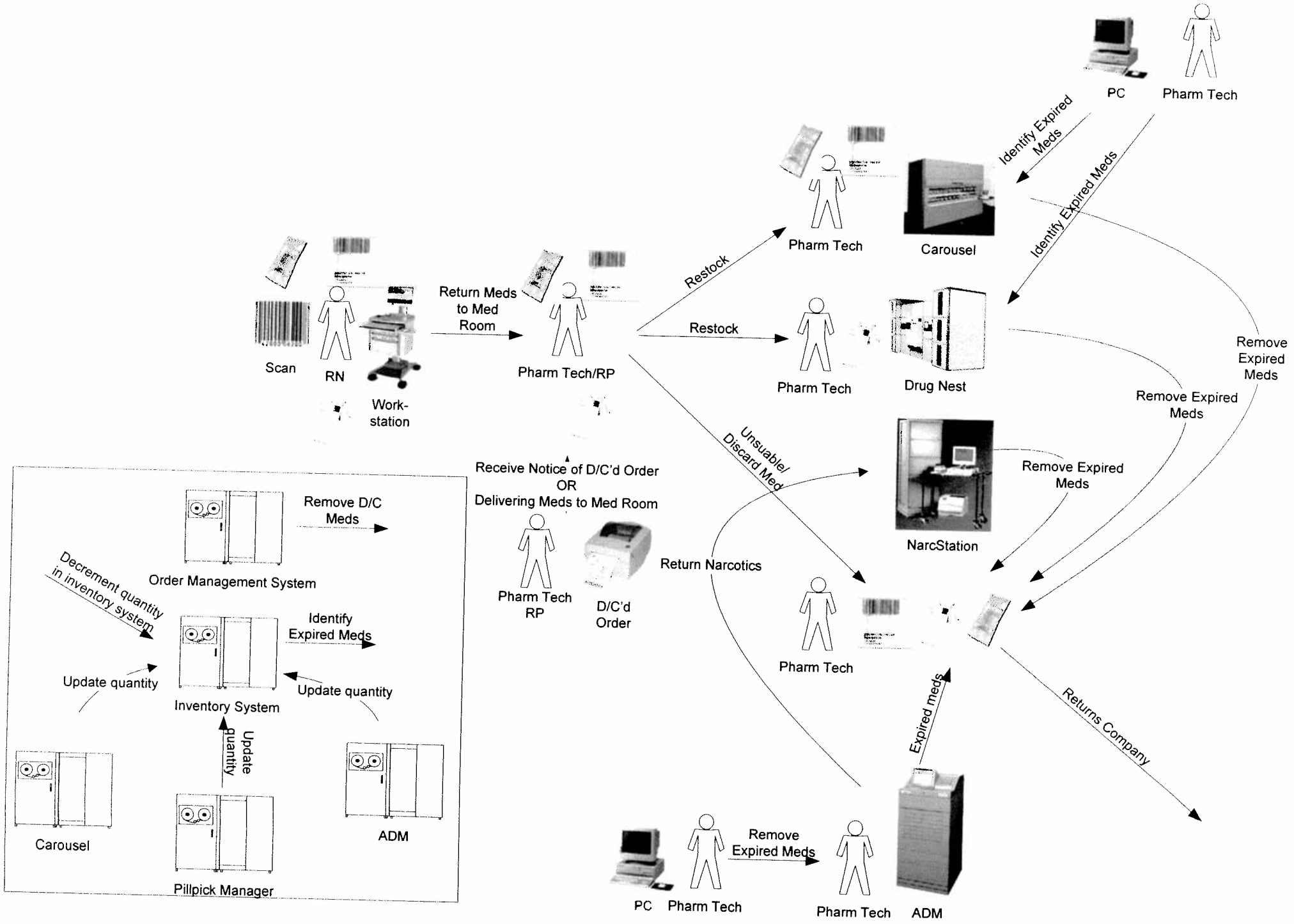

Picking/Storing
Order Management System
ADM Requests Refill
Pharm Tech
Order
Patient Order That Does Not Involve Meds in Robot
Carousel
Pharm Tech
Overwrapped Med
Store Meds In Med Room
Unit Sect. /RN
Scan
Receive Msg
Tube
Stat Meds, First Doses
Drug Nest
PickRing
Pick Meds Not Stored in Robot
Place on Ring
Verify Pick
Verify Check
Pharm Tech
Ring
Pharm Tech
Scan
RPh
Ring
PC
webMAR
Scan
Routine
RN
Pick Meds Not Stored in Robot
Verify pick
Deliver to Med Room
Pharm Tech
Scan
Pharm Tech
Retrieve Meds from Med Room
IV
Pharm Tech
IV
Restock ADM
NarcStation
ADM Requests Refill
Replenish ADM
Update quantity
Inventory System
Update quantity
Patient Specific Order
Order Management System
Status of Order by Scanning Barcode
Update quantity
Carousel
ADM
Patient Specific Order
Pillpick Manager
Pharm Tech
Overwrapped Med
ADM
RN
Retrieve Meds from Med Room
Work-station

Ordering

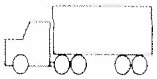

Written Order
MD
RN
Unit Secretary or RN
Scanner
PC
Scanned Order Reviewed & Verified
Electronic Order Reviewed and Verified
MD or RN
PC
RPh
PC
Verify order through webMAR
Verify order through webMAR
RN
Work-station
MD or RN
PC


Identify available items
Order Management System
Inventory System
Update quantity If Administered
Send order to pick
Pillpick Manager

Returns/Expired Medications



Packaging


Wholesaler

Receive Delivery
Check In Order


Unpackaged Meds

Pharm Tech


Carousel

Retrieve Unpackaged Meds from Carousel to Replenish Robot

Pharm Tech

Monitor Inventory Levels of Robot


PC

Inventory System

Pharm Tech

Store Packaged Meds in Carousel

Store Bulk (Robot) Items

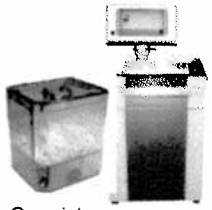

Unpackaged Meds

Pharm Tech

Replenish Robot

Pharm Tech


Shipment


Cannister

Box Station Packager

Load Meds Into Packager


Pharm Tech

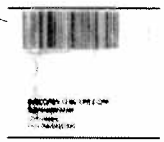

Auto Box Oral Solids Packager

Load Meds Into Packager


Unpackaged Meds

Pharm Tech

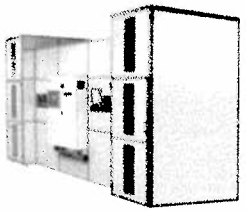

Auto Phial Packager (Overwrap -per)


Overwrapped Med

Pharm Tech

Retrieve Packaged Meds


PillPicker (Packager)

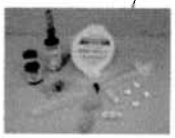

Drug Nest (Robot)

Meds Stored in Carousel


PickRing

Store in Holding Area Prior to Packaging

Package Meds


Unpackaged meds in Holding Area

Store in Safe Prior to Packaging

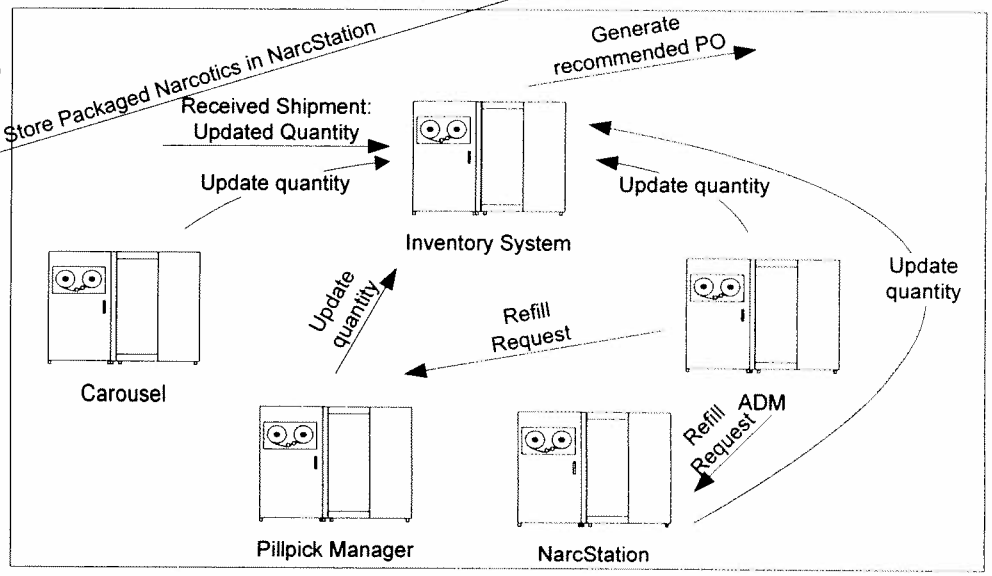
Package Meds


Unpackaged Meds in Safe

RPh


Overwrapped Med

Store Packaged Narcotics in NarcStation



Packaging

This is a quarterly estimate of the volume by form that would need to be packaged:

Form	Volume
Oral Solid	245,436
Vials	114,353
Disp. Syringes	25,838
Solutions	22,091
Ointments	10,840
Drops	1038
Creams	677
Irrig. Solutions	138
Lotions	46
Gels	23
Liquid Susp.	
Liquids	
Total	420,480

There are several bar-code packaging options to consider. If a robotic unit is used to dispense medication, there is a specific packaging option for each unit

This table illustrates the annual costs of packaging assuming the volume in the previous table above. *Note that the inclusion of personnel costs in the table below does not indicate a need for additional FTE's. The personnel costs are used for comparison purposes as McKesson offers an option to include personnel in its packaging solution.*

Packager	UDS	McKesson Pac-Plus (includes personnel and equipment)	McKesson In-House (Lease Equip) + Holy Name personnel + packaging supplies	UDS	McKesson In-House (Lease Equip) + Holy Name personnel + packaging supplies	PillPicker/ AutoBox/ AutoPhial/ BoxStation+ Holy Name personnel
Robot	McKesson RobotRx	McKesson RobotRx	McKesson RobotRx	NextRx MedCache	NextRx MedCache	swisslog PillPick
Annual Cost	203,204	269,107	202,843	203,204	269,107	185,357

UDS packages medication off-site. The McKesson and Swisslog options package medications on campus. The McKesson Pac Plus includes the personnel. The Swisslog option is more automated as it has the ability to load the robot directly from the packager.

Packaging Selection: Swisslog

The Swisslog robotic dispensing unit, Drug Nest, has been chosen in this proposal and it has packaging equipment that specifically works with the Drug Nest. One advantage of the Swisslog scheme is it can load packages directly into the robot. Other robots require someone to load the item into the robot after the item is packaged.

There are four modules to the Swisslog packaging solution. The process begins with the BoxStation module where the identity of the medication is associated with the container that is loaded into the system. Containers containing oral solids are loaded into the AutoBox module. The AutoBox module accepts multiple containers and loads each container in succession into the PillPicker, where each oral solid is packaged with a bar code. Other items are registered at the AutoBox and loaded into the AutoPhial that overwraps items such as vials, syringes, and blister packs. Once the item is overwrapped it is directly loaded into the robot, if that is the designated storage location.

- The quoted price for the packaging equipment is: $451,637
- The estimated annual packaging cost is: $185,357

A separate unit is required to place bar codes on items that would not be overwrapped.

- The estimated packaging equipment cost is $2,000

- The estimated annual packaging cost is: $170,000

Storage/Picking

Robotic Dispensing Unit

The following is the criteria used to compare the robots:

Functions
dispense medications by selecting item
dispense medications by patient
automates stocking of medications inside robot
maintains internal inventory
processes electronic Rx orders via interface
dispenses oral solids
dispenses vials
dispenses cups
dispenses syringes
dispenses ampoules
Features
places medications into bag
places medications into envelope
places medications on ring
places medications into cart drawer
capacity (line items)
capacity (unit doses) (largest config)
retrieve inventory levels electronically
interface with wholesaler
Performance
stocking rate (doses per hour)
dispensing rate (doses per hour)
accuracy rate
uptime

Cost
Purchase
Lease (Annual)
Implementation
Maintenance (Annual)
Other ongoing costs
Other
Footprint
Requires Packaging of All Medications
Noise
Support
Pharmacy Check Required
Time Needed for Implementation

There are three robot solutions that were evaluated: NextRx Med Cache, McKesson RobotRx, and Swisslog Drug Nest. The NextRx loads bar coded packages that do not have to conform to specific requirements other than its size must be small enough to fit in their storage slots. Medications are loaded onto a conveyor belt and they are stored in up to 3 drums that contain storage slots. The robot delivers picked medications via a conveyor belt. An operator must take the picked medications and place them into a bag or other container. This robot cannot load and dispense the items as it only has one robotic arm that executes the load and pick functions. The load rate is 400 doses per hour, while the pick rate is 1,000 doses per hour. It can hold a total of 2,400 individual items.

The McKesson RobotRx has very specific packaging requirements including a hole that allows it to be placed on one of many rungs that line the walls inside the robot. Picked items can be placed directly into an envelope or a cassette. This robot only has one arm and cannot load and dispense the items simultaneously. The pick rate and stocking rate of the RobotRx is 700 doses per hour.

Swisslog has specific packaging requirements including a hole that allows it to be placed on a pin inside the robot. It accepts packaged medications directly from its packaging equipment. This eliminates a manual step required by other robotic solutions. The difference between the McKesson and Swisslog solution is its storage scheme is more compact as the pins are placed on a series of rotating carousels. It also can house up to 2 robotic arms that allow it to simultaneously load and dispense medications at the same time. For each arm, the load rate of the Swisslog is 600 doses per hour, while the dispensing rate is 1,000 per hour.

Committee Recommendation: Swisslog

The Swisslog robotic offering is the Drug Nest. There are four features of this solution that differentiate it from the McKesson Robot-Rx and the NextRx MedCache: (1) the packaging is interfaced with the robot and items can be automatically stored in the robot once they are packaged, (2) it can both store and pick items simultaneously, (3) it can group medications on a ring making it easier to handle and locate items specific to a patient, (4) it has two robotic arms and if one fails, the other is still operational.

An internal sizing estimate and Swisslog recommendation indicates that the 3,550 pin model can meet our needs.

- The estimated cost is: $663,416

The following data illustrates an estimation of picks required for three exchanges per day. The pick hours estimation assumes that 80% of the picks are done by the robot and 20% are manual. The manual pick rate is an approximate pick rate if a carousel is used.

Average Number of Picks by Administration Time (Excludes PRNs, LV, PBs)

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0	99	104	104	108	108	98	98
1	1	1	1	1	1	1	1
2	97	99	102	105	105	98	99
3	1	1	1	1	1	1	1
4	1	2	2	2	1	1	1
5	0	0	1	0	0	0	0
6	215	223	225	232	232	216	216
7	13	18	18	15	16	12	14
8	36	39	39	55	49	26	28
9	34	35	32	44	35	22	24
10	1110	1147	1157	1157	1140	1044	1048
11	35	37	42	44	39	31	29
12	118	122	129	132	131	110	111
13	21	23	23	26	22	19	16
14	218	226	240	232	223	202	201
15	17	16	21	18	14	13	11
16	21	19	24	22	19	18	17
17	15	15	15	14	12	11	11
18	634	653	663	653	657	604	599
19	14	14	13	13	13	9	8
20	19	18	16	21	19	13	13
21	14	12	12	15	12	8	8
22	430	443	445	426	432	390	387
23	8	10	8	10	8	4	4
Total Picks	3173	3277	3330	3346	3289	2953	2946

NOTE: Current Average # of Picks for 24 Hr. Exchange (Oct 26 - Nov 9): 1221

Pick Hours Estimation

Assumptions:
80% of picks are from robot
Robot Pick Rate (per hour): 600
Manual Pick Rate (per hour): 100

3 EXCHANGE SCENARIO: 9AM, 5PM, 11PM

Based upon Wednesday

10am-5pm			2 TECHS		1TECH		3TECHS	
Picks 80%	20%	Robot Hours	Techs Hours		Techs Hours		Techs Hours	
1320	330	2.2	1.7		3.3		1.1	

6pm-1am			2 TECHS		1TECH		3TECHS	
Picks 80%	20%	Robot Hours	Techs Hours		Techs Hours		Techs Hours	
1013	253	1.7	0.9		2.5		0.6	

2am-9am			2 TECHS		1TECH		3TECHS	
Picks 80%	20%	Robot Hours	Techs Hours		Techs Hours		Techs Hours	
363	91	0.6	0.3		0.9		0.2	

2 EXCHANGE SCENARIO: 9AM, 5PM

Based upon Wednesday

10am-5pm			2 TECHS		1TECH		3TECHS	
Picks 80%	20%	Robot Hours	Techs Hours		Techs Hours		Techs Hours	
1320	330	2.2	1.7		3.3		1.1	

6pm-9am			2 TECHS		1TECH		3TECHS	
Picks 80%	20%	Robot Hours	Techs Hours		Techs Hours		Techs Hours	
1376	344	2.3	1.3		3.4		0.8	

Carousel

The evaluated solutions include OmniCell, McKesson MedCarousel and the Pyxis Carousel. The basic functionality of the carousels is the same. Each has the ability to automatically present a shelf corresponding to an order sent electronically. They also have lights that indicate the location of the item on the shelf.

Committee Recommendation: McKesson

The difference lies in the software. The primary advantage of the McKesson software is that it has the ability to manage inventory inside and outside the carousel. The software can also generate an electronic version of a suggested order that can be checked prior to being sent to the wholesaler.

- The estimated cost of purchasing a carousel is: $250,000

ADM

The three solutions considered include OmniCell Pharmacy Central, McKesson AccuDose, and the Pyxis MedStation. Each ADM solution has the same basic functionality. It limits access to a medication stored in a drawer and has the ability to restrict the user to a single dose. The ADM's can also interface with an order system enabling the Pharmacy to control access by dispensing the medication only if the order has been profiled. The systems also track usage and allow Pharmacy and Nursing to monitor appropriate medication usage.

Committee Recommendation: McKesson

The McKesson Acudose is also integrated with the inventory management software used with the McKesson MedCarousel. The ADM can electronically communicate the need to replenish items and as well as real-time updates on inventory levels.

- The estimated cost of purchasing the ADM's is: $650,000

Unit	Recommended Cabinet
Lobby North	2 Drawer
Output Clinic	2 Drawer
Hemo Acute	Smallest Available
Hemo Chronic	Smallest Available
Hemo Self	Smallest Available
ED	Same as current
1 North	4 Drawer
1 East (5MR)	2 Drawer
Interventional Radiology	2 Drawer
Other Radiology Areas	TBD
MRI	Smallest Available
2 Marian	2 Drawer
ICU	5+ Drawer
OR	TBD
PACU	4 Drawer
SDS	2 Drawer
Cardiac Cath	2 Drawer
Endoscopy	2 Drawer
3 Marian	2 Drawer
LDRP	2 Drawer
SCN	TBD
4 Marian	2 Drawer
HNP	2 Drawer
5 Marian	2 Drawer
6 Marian	2 Drawer
Pediatrics	2 Drawer
MICU	2 Drawer

Workstation Evaluation

The carts considered include Artromick initi, Rubbermaid eMAR2, Lionville iCart, J Mobility Z-Cart, and the Flo 1750. Evaluated features include the storage configuration, workspace, locking mechanism, mobility, option to add a laptop/all-in-one/tablet pc.

Committee Recommendation:

The Artromick has the size and storage scheme to meet the needs of the organization. It has an electro-mechanical locking mechanism that can be setup to limit access to certain individuals. It also features an all-in-one PC with a wireless card. It is easy to replace this unit in case of failure.

- The estimated cost of purchasing carts with storage is: $451,000

These systems eliminate paper and facilitate inventory management tasks. It also assists in identifying drug diversion. The solutions for 2 vendors have been reviewed: the Cardinal c2 safe and McKesson NarcStation.

Committee Recommendation:

The McKesson NarcStation is also integrated with the inventory management software used with the McKesson MedCarousel and Accudose units. The NarcStation can electronically communicate the need to replenish items and as well as real-time updates on inventory levels.

- The estimated cost of this item is: $55,000

COST SUMMARY

The following table summarizes the purchase and maintenance costs. It does not include implementation costs such as training or modifications to the facility.

Purchase Costs		
Swisslog Packaging Equipment	$ 451,637	
Packaging Equipment	$ 2,000	
Swisslog Robot	$ 663,416	
McKesson Carousel	$ 250,000	
McKesson ADM	$ 650,000	
McKesson NarcStation	$ 50,000	
McKesson Connect-Rx	$ 130,000	
Artromick Workstation Carts	$ 580,000	
Sub Total		$ 2,777,053

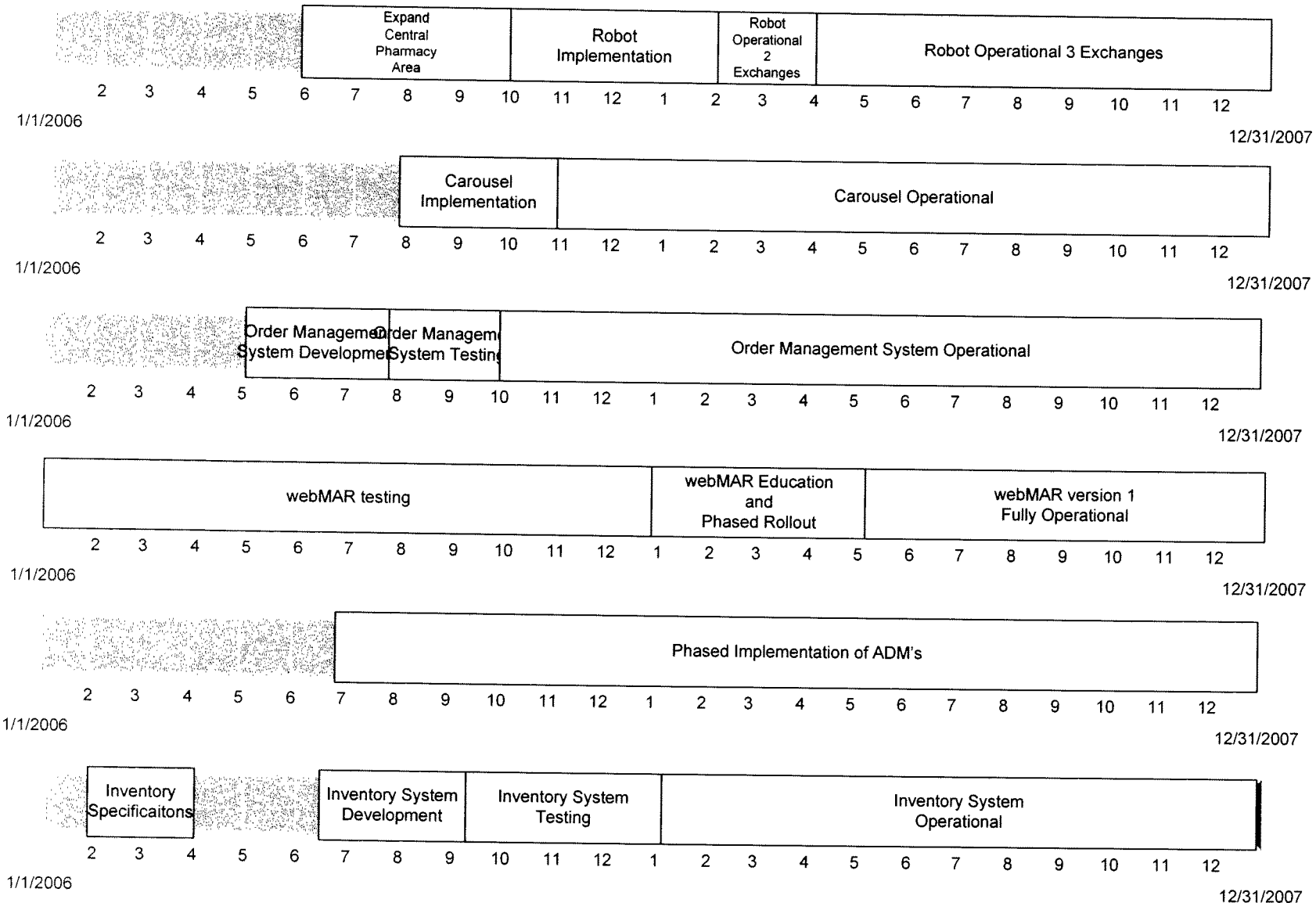
Annual Operational Costs		
Packaging	$ 170,000	
Training		
Sub Total		$ 170,000

Annual Maintenance Costs		
Swisslog	$ 9,450	
McKesson Carousel	$ 18,000	
McKesson ADM	$ 31,824	
NarcStation	$ 1,500	
ConnectRx	$ 1,500	
IT Interface Maintenance		
Sub Total		$ 59,274

Implementation Costs		
Software Development		
Training		
Sub Total		$ -

Additional FTE		
1 IS RPh (includes benefit costs)	$ 100,000	
Sub Total		$ 100,000

Overall Total	$ 3,106,327


Expand Central Pharmacy Area
Robot Implementation
Robot Operational 2 Exchanges
Robot Operational 3 Exchanges
2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
1/1/2006
12/31/2007
Carousel Implementation
Carousel Operational
2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
1/1/2006
12/31/2007
Order Management System Development
Order Management System Testing
Order Management System Operational
2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
1/1/2006
12/31/2007
webMAR testing
webMAR Education and Phased Rollout
webMAR version 1 Fully Operational
2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
1/1/2006
12/31/2007
Phased Implementation of ADM's
2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
1/1/2006
12/31/2007
Inventory Specificaitons
Inventory System Development
Inventory System Testing
Inventory System Operational
2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
1/1/2006
12/31/2007

APPENDIX A: COMPARISON OF STORAGE ALTERNATIVES

CRITERIA

- Medications stored close to the patient
- Minimize medications on the unit
- Minimize resources needed to deliver/distribute medications to storage unit(s)
- Minimize resources needed to retrieve unused medications

ALTERNATIVES

SOLUTION	BENEFITS	PROBLEMS	COST
MED ROOM – store all patient specific meds and floor stock in medication room	*Productivity* ○ all meds in one place; centralized (All in one area) ○ delivering to central med room easier for Pharmacy; exchange is relatively easy ○ meds delivered directly to patient bin (replaces drop off bin)	*Patient safety* ○ borrowing ○ distractions occur walking back and forth from med room increase chance of mistake ○ increase chance of mistake from distractions, too many nurses in one room, may chat ○ could grab wrong med *Productivity* ○ meds far away from patient; too much back & forth ○ nurses can't individualize supplies for patient ○ supplies not readily in one place ○ if room size is not large enough, too many nurses in one room may clutter (2M, 3M, 4M, 6M are not large enough to support this concept)	$1,250 per room (addt'l cost for gutting and modifying other rooms)
NURSE SERVER	*Patient Safety* ○ less missing meds ○ meds and supplies as close to patient as possible ○ no borrowing *Productivity* ○ very individualized ○ closer to patient ○ less chance of errors ○ less floor stock needed ○ less missing meds ○ if server has flag can alert RNs to newly arrived meds *Resource* ○ floor stock still centralized	*Productivity* ○ takes more time for Pharmacy to stock ○ restocking supplies (by who?) ○ potential for RN/PCA shift problems ○ some items still in med room (i.e. large vol. IV's)	$1,000 per nurse server

SOLUTION	BENEFITS	PROBLEMS	COST
MED SUBSTATION – store all patient specific meds and floor stock in substations spread throughout the unit.	store all patient specific meds and floor stock in substations spread throughout the unit: *Patient safety* ○ decrease chance of making mistake as substation is closer to patient room *Productivity* ○ location, closer to patients store all patient specific meds in substation spread throughout the unit; store floor stock in medication room *Productivity* ○ closer to patients	store all patient specific meds and floor stock in substations spread throughout the unit: *Patient safety* ○ med rooms not stocked properly; hard to keep stocked properly *Productivity* ○ more stocking required ○ increased delivery time and stocking ○ med rooms not stocked properly *Resources* ○ more stock required store all patient specific meds in substation spread throughout the unit; store floor stock in medication room *Patient safety* ○ borrowing *Productivity* ○ need to know what items are kept where ○ can be confusing for new staff or when people relocate things	$5,000 per substation (8 patients)
CURRENT SYSTEM: CARTS	*Productivity* ○ individualized (5M) ○ mobile (5M, 6M) ○ convenient – everything in one place ○ decentralizes narcotics *Patient Satisfaction* ○ patients see you preparing meds	*Patient Safety* ○ borrowing ○ problems locking cart ○ mechanical breakdowns *Productivity* ○ boxes get mixed up and scattered (5M) ○ mechanical breakdowns ○ carts not moved; walk up and down the hall ○ IV's are kept separate ○ keys (5M)	

SOLUTION	BENEFITS	PROBLEMS	COST
MOBILE WORKSTATIONS	*Patient safety* ○ decrease chance of making mistake as substation is closer to patient room *Productivity* ○ individualized ○ mobile (5M, 6M) ○ convenient ○ improved efficiency ○ can be used for documentation other than meds *Patient Satisfaction* ○ patients see you preparing meds ○ improves patient safety- one patient at a time ○ supplies required for med admin can be in the cart	*Patient Safety* ○ borrowing	$6000 per cart

APPENDIX B: COMPARISON OF ROBOT ALTERNATIVES

	McKesson RobotRx	Comments Regarding RobotRx	NextRx MedCache	Comments Regarding MedCache	swisslog PillPick	Comments Regarding RobotRx
dispense medications by selecting item	X		X			
dispense medications by patient	X		X		X	
automates stocking of medications	X	Operator needs to put meds on rungs	X	*Convenient* – dump all meds into hopper	X	
maintains internal inventory	X		X		X	integrated with packaging
processes electronic Rx orders via interface	X		X		X	
dispenses oral solids	X		X		X	
dispenses vials	X		X		X	
dispenses cups	X	depends upon size	X	depends upon size	X	depends upon size
dispenses syringes	X	depends upon size	X	depends upon size	X	depends upon size
dispenses ampoules	X		X		X	
places medications into bag			X	Packager very noisy; 80 dB's		
places medications into envelope	X	automated				
places medications on ring					X	keeps meds for patient together
places medications into cart drawer	X	automated, conveyor belt - user said	X	Operator positions drawer - manual	X	automated, conveyor belt
capacity (line items)	2500+		~200	Each drum ~600 items; 4 drums total	2200+	
capacity (unit doses) (largest config)	30,000+		2400		44,000	
retrieve inventory levels electronically	X	integrated inventory	X		X	
interface with inventory solution	X	integrated w/McKesson solution				
interface with wholesaler	X	interface w/ Mckesson Wholesaler			X	has interface ready - not built
stocking rate (doses per hour)	700		400		600	2 robot arms; multi-task store/dispense
dispensing rate (doses per hour)	700		1200		1000	2 robot arms; multi-task store/dispense
accuracy rate	99.90%		99.70%		99.99%	
uptime	96-98%		*98.90%	promise 98.9%	98%	2 robot arms act independently
Purchase	1,000,000		500,000		1,125,428	includes packaging
Lease (Annual)	100,000		-		256,995	
Implementation	-	train/instl included	-	train/instl included	-	train/instl included
Maintenance (Annual)	90000		100,000		114000	
Footprint	12 x 14 x 8	octagon config (or 24 x 9 x 8	9 x 4.5 x 7	Recommend 15x10 work area	26 x 14 x 8.75	need 31 x 19 x 9 area
Requires Packaging of All Medications	X	Specific packaging requirements		Requires only a bar code	X	pkg sol interfaced w/ robot
Noise		Noisy		Not very noisy		some noise when packaging
Support		supports 10 other robots in nj		1 tech in area		techs need to be trained - few installs
Pharmacy Check Required			X		X	
Time Needed for Implementation		6 months		6 months		6 months

HNH WebHIS - Medication Administration Record - Windows Internet Explorer

http://10.100.15.184/cgibinp/ARGADM2.pgm

File Edit View Favorites Tools Help

HNH WebHIS - Medication Administration Record

Holy Name Hospital

You're logged in as: MICHAEL SKVARENINA Logout Menu

Patient: [redacted] **No WristBand Scanned** **MR#:** [redacted] **DOB:** [redacted] Patient list | Patient record

LOC: 5MR 527-2 **Last transport:** VAS-->527-2 Completed 11:24 **In-House Act#:** [redacted] **Admitted:** 03/31 **LOS:** 58

Diet: REGULAR DIET

Admitting DX: OSTEOMYELITIS W/CEULLILITIS

Attending MD: [redacted] Pantagis,Stefanos

Allergies: *** NO KNOWN ALLERGIES ***

Medication: **(metolazone) ZAROXOLYN Tablet 2.5 MG**

Oral , Once Daily

Due: 05/27 10:00

22491207

Last dose: 05/26 11:08

By: NAVALTA M

Pertinent Clinical Data

What's this?

	Normal	05/23 05:30	05/24 13:46	05/27 05:30
POTASSIUM	(3.5-5.3)	4.8	4.4	4.4

Give Medication

Medication not given reason

NPO | Outdated | Sleeping

Diagnostic Study | Pt Refused | Other

Cancel

Trusted sites 100%

Appendix B - 1

HNH WebHIS - Medication Administration Record - Windows Internet Explorer

http://10.100.15.184/cgibinp/ARGADM2.pgm

File Edit View Favorites Tools Help

HNH WebHIS - Medication Administration Record

Holy Name Hospital

You're logged in as: **MICHAEL SKVARENINA** Logout Menu

Patient: [redacted] **No WristBand Scanned** **MR#:** [redacted] **DOB:** [redacted] BT: **O+** Patient list Patient record

LOC: ICU 239-1
Diet: NPO(STRICT)
Admitting DX: AMS ALTERED MENTAL STATUS
Allergies: PENICILLIN

In-House Act#: [redacted] **Admitted:** 05/21 **LOS:** 7
Attending MD: **Schoen,Arnold**

Medication: **(heparin sodium) HEPARIN Solution 5000 Units**
Subcutaneous , Every 12 hours

Due: 05/27 22:00
22490289

Last dose: 05/27 10:45
By: BORROWS W

Pertinent Clinical Data What's this?

	Normal	05/25 05:30	05/26 05:30	05/27 05:30
PTT				
PLATELET COUNT	(146-379)	288	227	193

Give Medication

Medication not given reason

NPO | Outdated | Sleeping
Diagnostic Study | Pt Refused | Other

Cancel

Trusted sites 100%

Appendix B - 2

HNH WebHIS - Medication Administration Record - Windows Internet Explorer

http://10.100.15.184/cgibinp/ARGADM2.pgm

File Edit View Favorites Tools Help

HNH WebHIS - Medication Administration Record

Holy Name Hospital

You're logged in as: MICHAEL SKVARENINA | Logout | Menu

Patient: [redacted] **No WristBand Scanned** **MR#:** [redacted] **DOB:** [redacted] Patient list | Patient record

LOC: 5MR 527-2 **Last transport:** VAS-->527-2 Completed 11:24 **In-House Act#:** [redacted] **Admitted:** 03/31 **LOS:** 58

Diet: REGULAR DIET

Admitting DX: OSTEOMYELITIS W/CEULLILITIS

Attending MD: Pantagis,Stefanos

Allergies: *** NO KNOWN ALLERGIES ***

Medication: **(simvastatin) ZOCOR Tablet 40 MG**

Oral , Once daily at 10 pm

Due: 05/27 22:00

22437312

Last dose: 05/26 21:38

By: PARK J

Pertinent Clinical Data

What's this?

	Normal	05/14 05:30	05/19 05:30	05/27 05:30
CRMB (MASS)	(0.6-6.4)	1.4		
AST	(15-41)	16	L 12	L 14
ALT	(17-63)	17	L 13	20

Give Medication

Medication not given reason

NPO | Outdated | Sleeping

Diagnostic Study | Pt Refused | Other

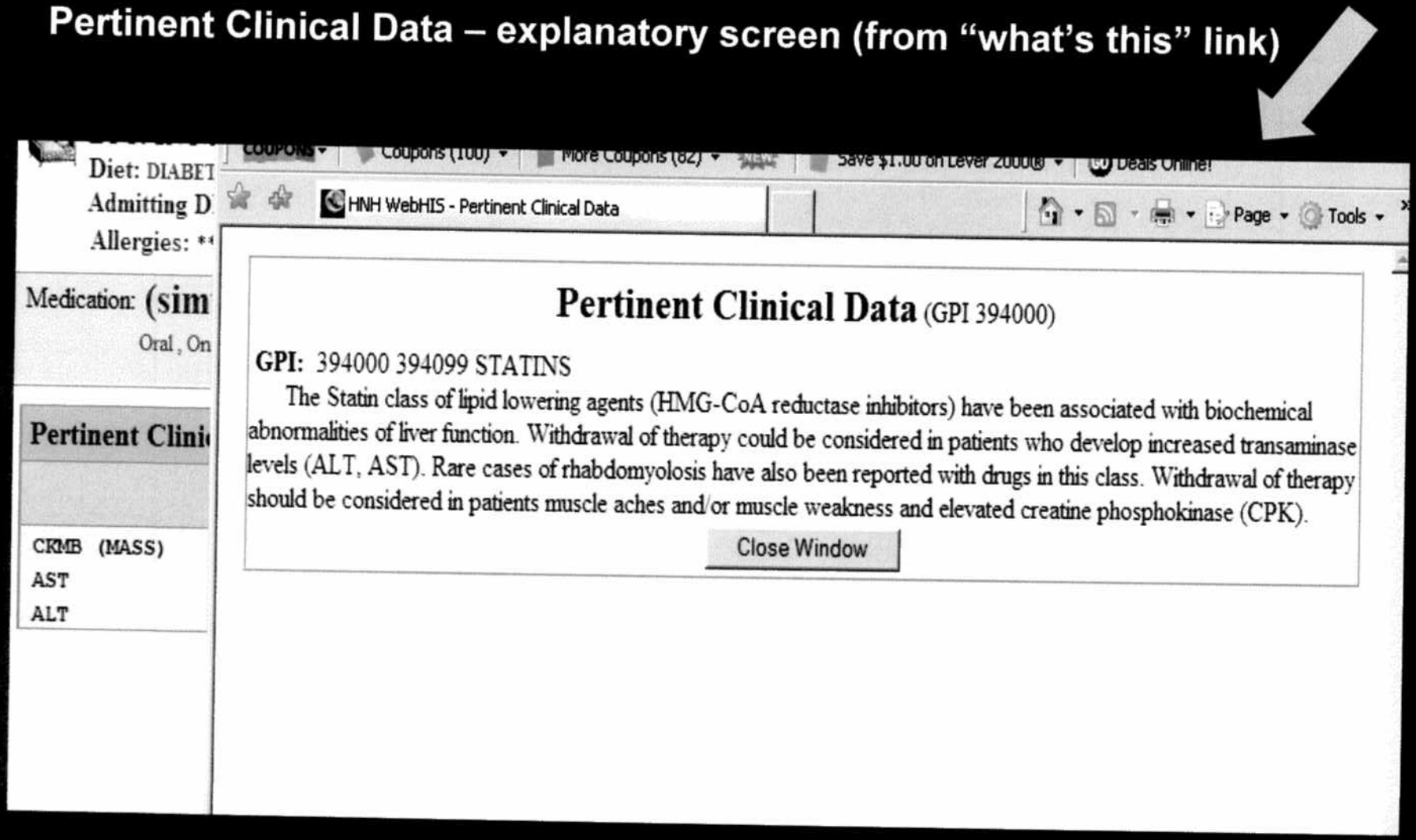
Cancel

Trusted sites 100%

Appendix B - 3

Pertinent Clinical Data

Pertinent Clinical Data – explanatory screen (from "what's this" link)



HNH WebHIS - Medication Administration Record - Windows Internet Explorer

http://10.100.15.184/cgibinp/ARGADM2.pgm

File Edit View Favorites Tools Help

HNH WebHIS - Medication Administration Record

Holy Name Hospital

You're logged in as: MICHAEL SKVARENINA | Logout | Menu

Patient: [redacted] **No WristBand Scanned** **MR#:** [redacted] **DOB:** [redacted] BT: O+ Patient list | Patient record

LOC: 5MR 515-1
Diet: TUBE FEEDING-SPECIFY(NEPRO@30ML/HR)
Admitting DX: PNEUMONIA
Allergies: *** NO KNOWN ALLERGIES ***

In-House Act#: [redacted] **Admitted:** 05/22 **LOS:** 6
Attending MD: Lee,Karen

Medication: (tobramycin sulfate) TOBRAMYCIN Solution 300 MG
Inhalation , Daily at 8:00 & 20:00

Due: 05/27 08:00
22492061

Last dose: 05/25 20:14
By: PIPITO N

Pertinent Clinical Data What's this?

	Normal	05/24 05:30	05/25 05:30	05/26 05:30
CREATININE	(0.40-1.10)	H 1.13	H 1.70	H 1.87

Give Medication

Medication not given reason

NPO | Outdated | Sleeping
Diagnostic Study | Pt Refused | Other

Cancel

Trusted sites 100%

Appendix B - 5

HNH WebHIS - Medication Administration Record - Windows Internet Explorer

http://10.100.15.184/cgibinp/ARGADM2.pgm

File Edit View Favorites Tools Help

HNH WebHIS - Medication Administration Record

Holy Name Hospital

You're logged in as: MICHAEL SKVARENINA | Logout | Menu

Patient: [redacted] **No WristBand Scanned** **MR#:** [redacted] **DOB:** [redacted] Patient list | Patient record

LOC: 4MR 409-2 **Last transport: ENDO-->4MR Awaiting dispatch**

Diet: NPO FOR TEST-DATE IN COMMENTS(72 CAL. CT. 5/24 TO 5/27, NPO 5/27FOR PEG PLACEMENT)

In-House Act#: [redacted] **Admitted: 05/20** **LOS: 8**

Attending MD: Law,Gregory

Admitting DX: TIA

Allergies: HAYFEVER ALLERGY, OTHER - SPECIFY IN OTHER

Medication: **(lisinopril) ZESTRIL Tablet 20 MG**

Oral , Once Daily

Due: 05/28 10:00

22502868

Last dose: 05/26 10:01

By: HOVAN K

Pertinent Clinical Data What's this?

	Normal	05/25 05:30	05/26 05:30	05/27 06:35
CREATININE	(0.70-1.30)	H 1.36	H 1.55	H 1.63

***Blood Pressure**

Enter

05/27/08 08:09 139/76

Medication not given reason

NPO | Outdated | Sleeping

Diagnostic Study | Pt Refused | Other

Cancel

Trusted sites 100%

Appendix B - 6

Scanning Patient Wristband

Diet: DIABETIC 1800 CALORIE

Admitting DX: RENAL FAILURE

Allergies: *** NO KNOWN ALLERGIES ***

Attending MD: [redacted] Benoff,Brian

Scan the Patient Wristband

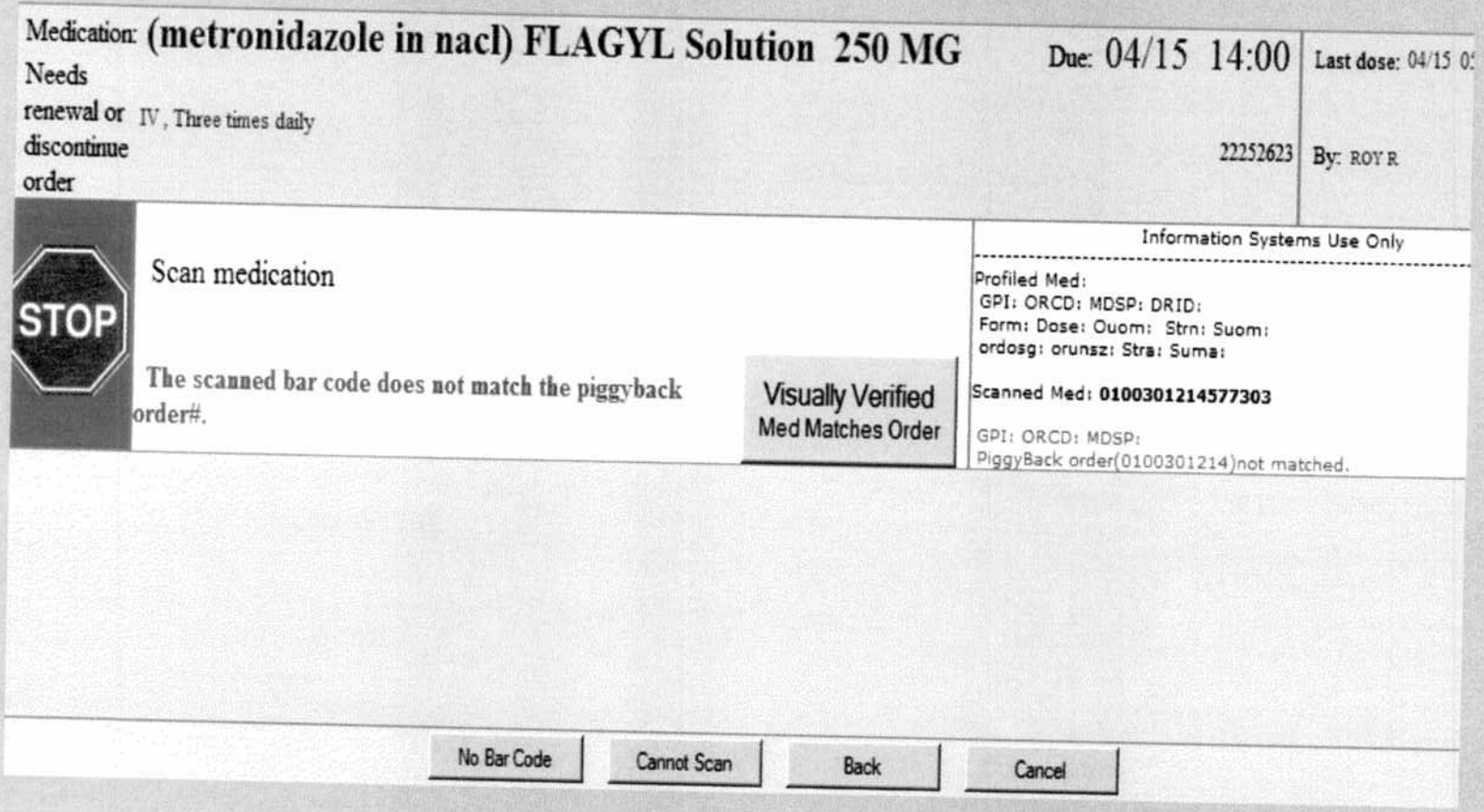
If unable to scan the patient wristband, select a reason below to continue.

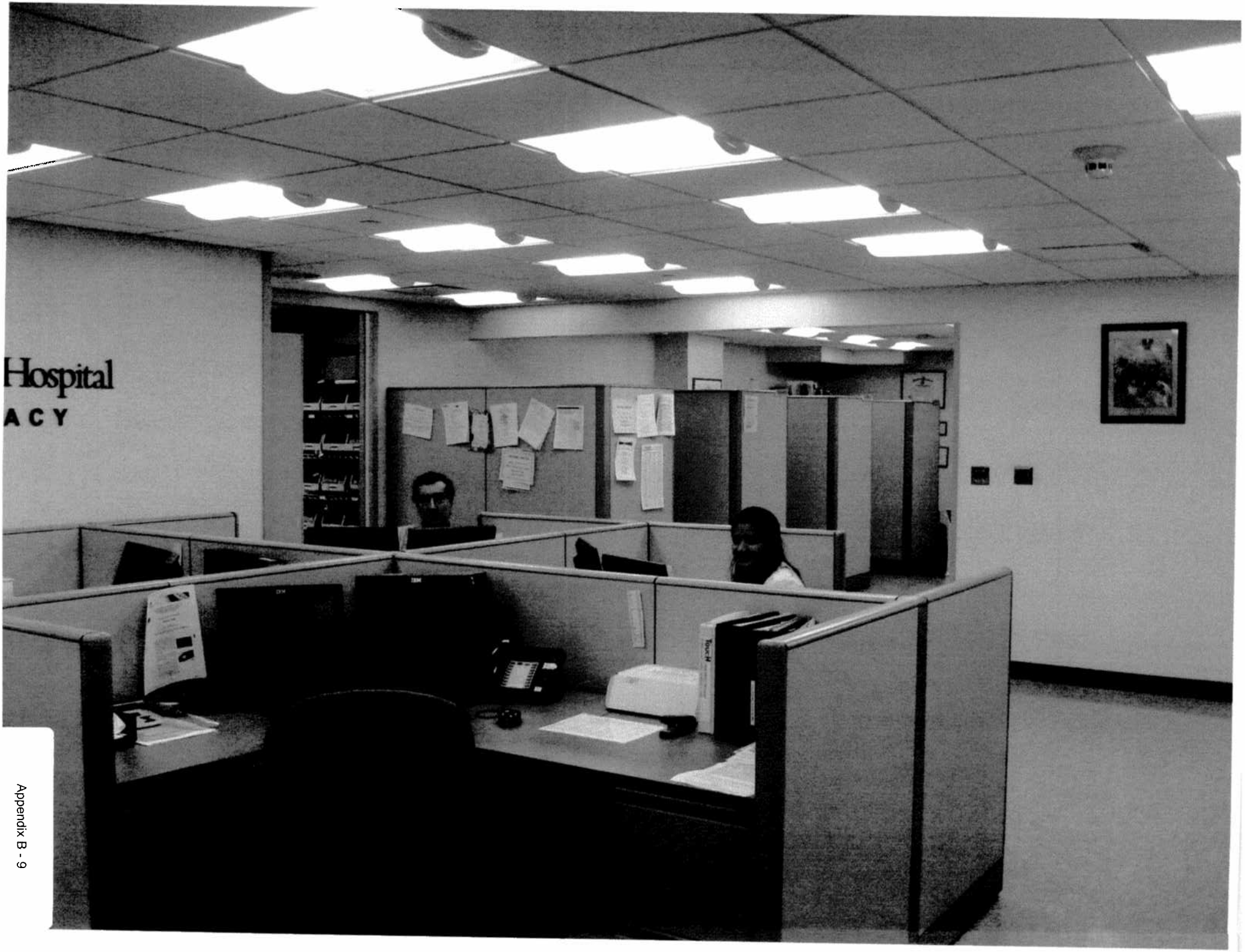
Barcode does not read	Barcode scanner does not work	Patient does not have wristband/missing	Patient not available

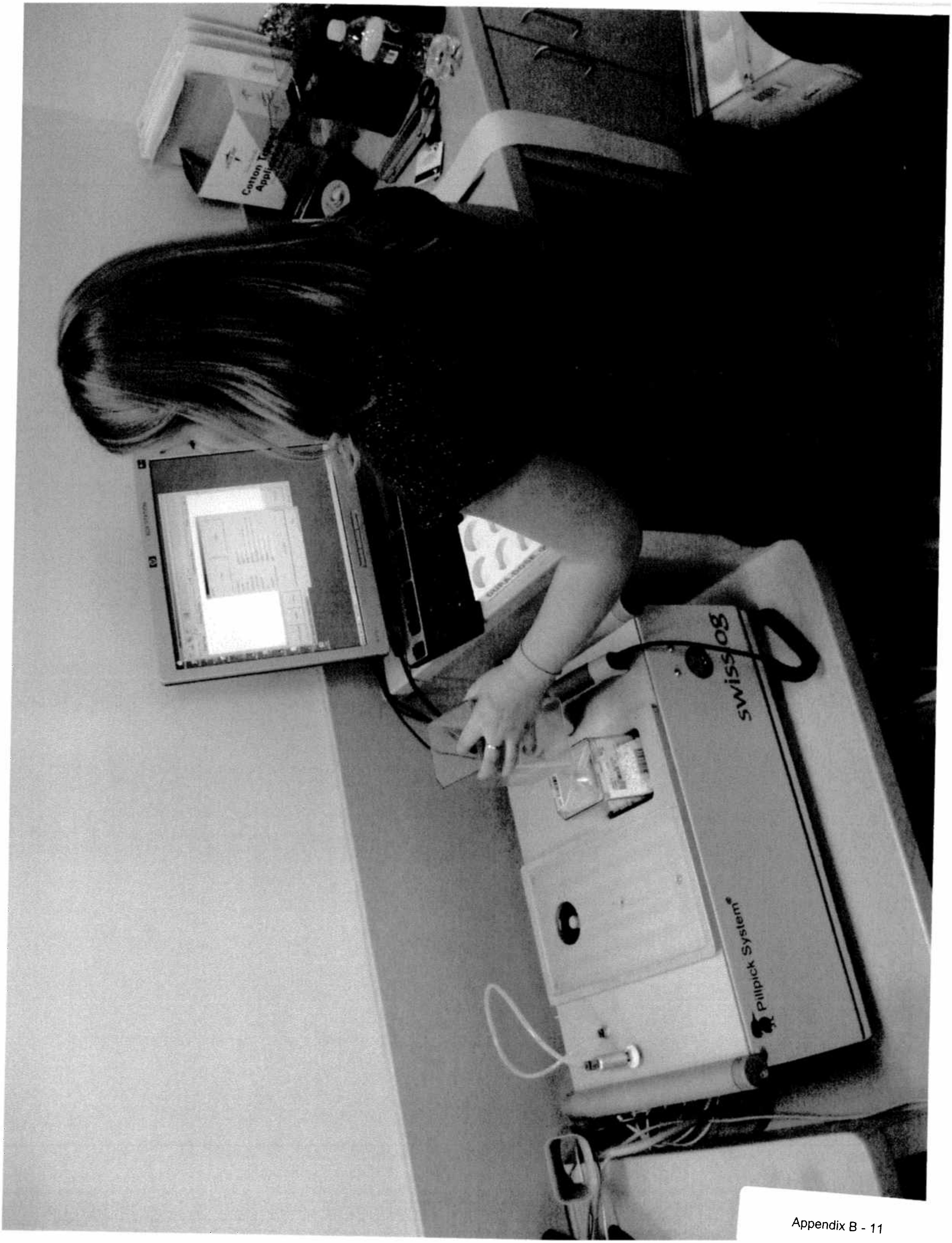
Back

Error Reduction

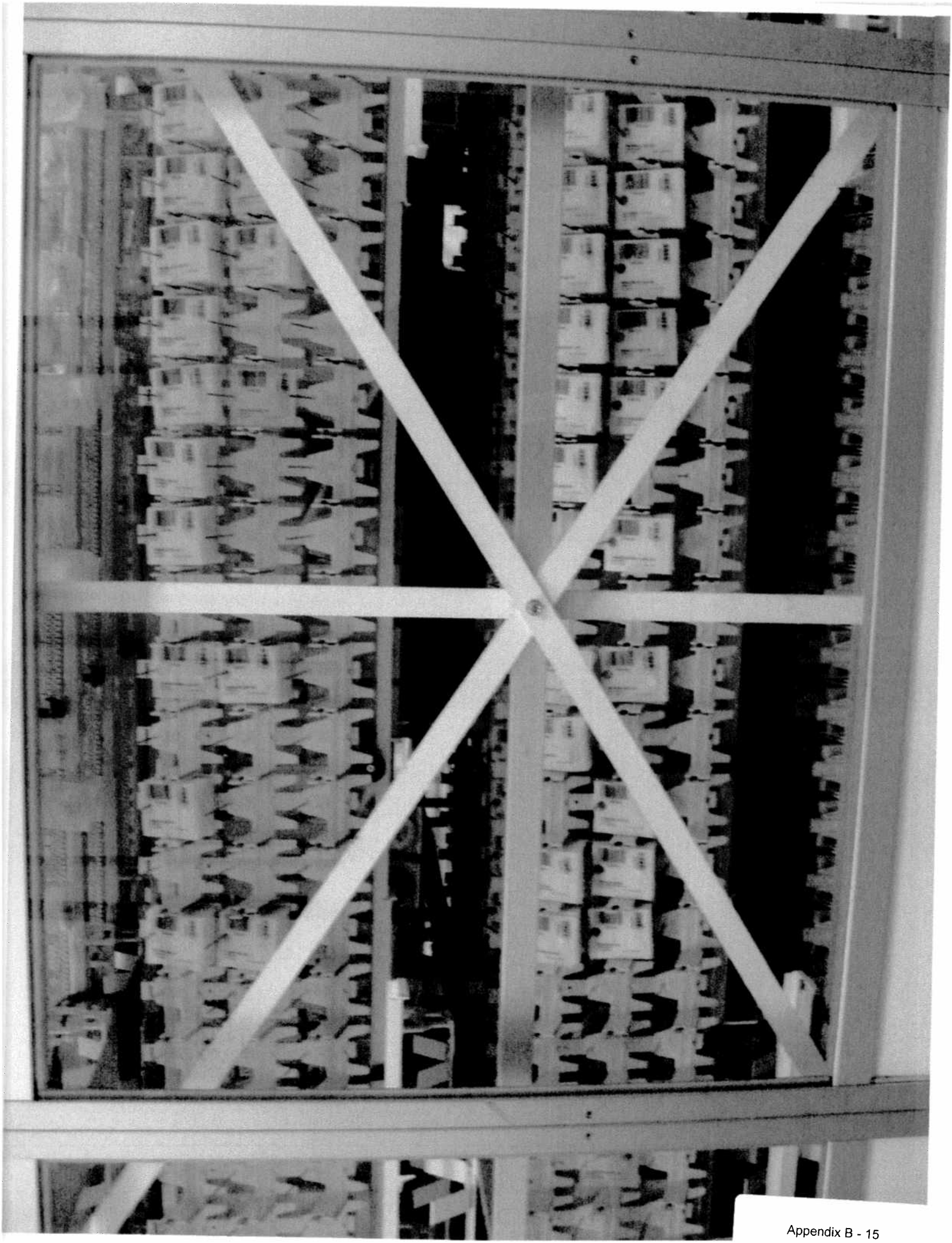
Mismatched Scanned Medication:

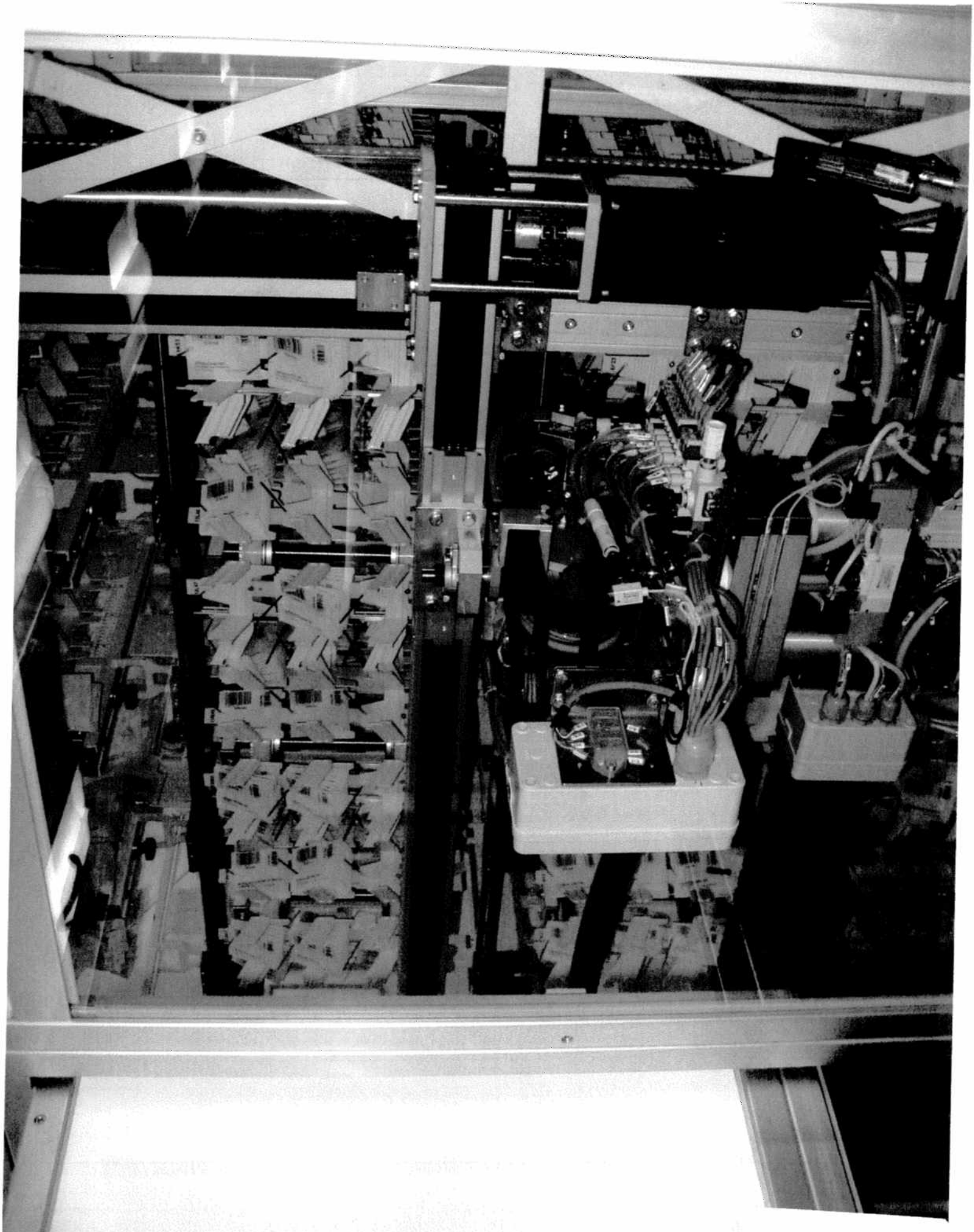



Hospital
ACY


swisslog
Pillpick System®


swisslog

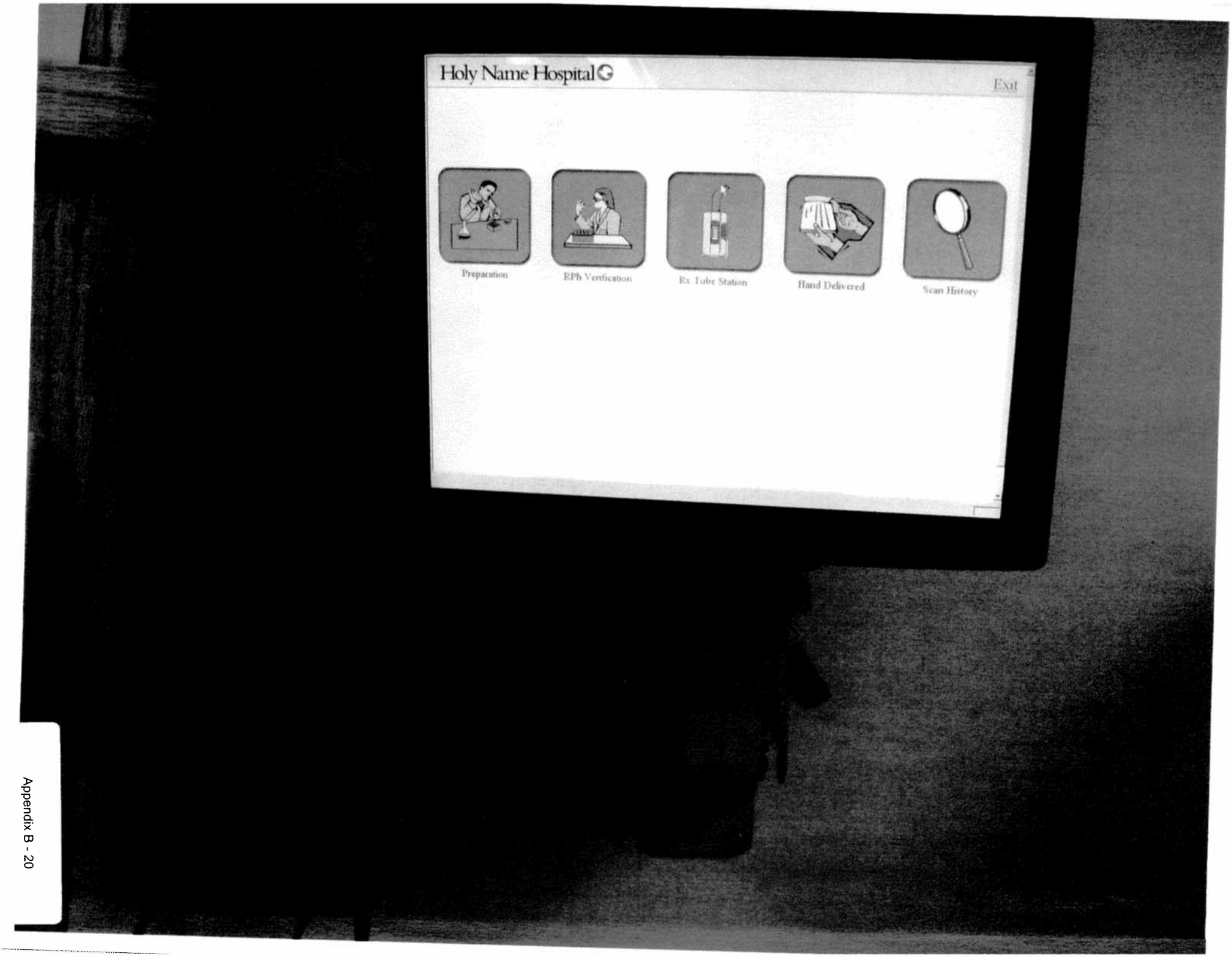





Do Not Scan
ACETAMINOPHEN 650MG (2x325 TAB)
(TYLENOL)
Lot 7G010105
Exp 04/02/2009


ACETAMINOPHEN 650MG (325MG TAB)
Do Not Scan


SCAN HERE
Do Not Scan
HYDRALAZINE HCL 50MG TABS
(APRESOLINE)
Lot 32827020A
Exp 03/14/2009
Exp 03/14/2009
1/1
1NO
Room-Bed 132-2
HYDRALAZINE HCL 50MG TABS
HYDRALAZINE HCL 50MG TABS
CART UPDATE


Holy Name Hospital
Exit
Preparation
RPh Verification
Rx Tube Station
Hand Delivered
Scan History